THE IMPACT OF MRP II IMPLEMENTATION AT OGDEN AIR LOGISTICS CENTER ON FUTURE AIR FORCE LOGISTICS COMMAND IMPLEMENTATIONS

THESIS

John M. Faulkner
Captain, USAF

AFIT/GLM/LSG/89S-21

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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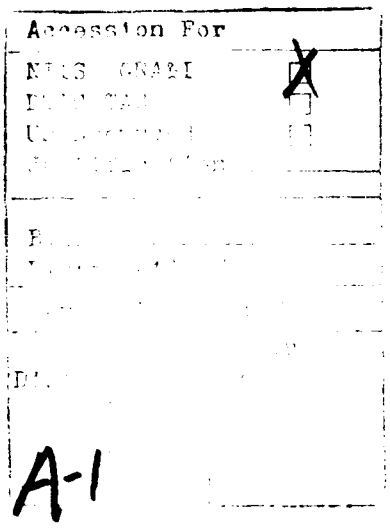

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THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
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Requirements for the Degree of
Master of Science in Logistics Management

John M. Faulkner
Captain, USAF

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Preface

This research has been a terrific eye opener for me from the first day until the last. Initially I was overwhelmed by the beautiful simplicity of the MRP concept. This naivety was soon replaced by awe at the tremendous complexity involved with implementing the system. Those people working on the MRP II system in AFLC and particularly at Ogden ALC have my utmost respect.

Certainly no research of this bulk is accomplished without the assistance of many. I would like to first thank my very patient family, Judi and Sarah, for their encouragement and selflessness. Lt Col Phillip E. Miller went above and beyond the call of duty to educate, guide, and advise this "operator" in the ways of production. Without his help I could never have made it.

Data collection required the cooperation of both HQ AFLC and the Ogden Air Logistics Center. A special thanks to Mr. Ed Goode, Mr. Fidal Rodriguez, and Mr. Terry White for their time, patience, and talents. The help they provided was essential to the success of this thesis.

John M. Faulkner

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Abstract

The research examines Manufacturing Resource Planning (MRP II) implementation at the Ogden Air Logistics Center (OOALC), Hill AFB, Utah. This study is a follow-up to a 1988 thesis which focused specifically on the Industrial Products and Landing Gear Division at OOALC.

The research is divided into three areas: an historical perspective of the implementation; analysis of previously identified problem areas; and a discussion on success probability. Each area is analyzed based on primary and secondary data.

Literature is reviewed with particular emphasis placed on the basic elements of a MRP II system and the recommended path to implementation success. This secondary information was later contrasted with the data collected specifically for this research.

Information for the study was collected using personal interviews and a questionnaire. Data sources were used in Headquarters, Air Force Logistics Command and at OOALC. The information from each data collection instrument was complementary and provided supporting data for conclusions.

The research concludes that while the personal commitment and abilities of those involved with the project are exemplary, the plan and constraints on the implementation may undermine the chances of project success.

Recommendations for improving the chances of success are also included. Additionally, encouragement for future study is offered.

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I. Introduction

General Issue

Manufacturing Resources Planning (MRP II) implementation has been ongoing at the Ogden Air Logistics Center (OOALC) since April of 1986. MRP II installation is part of an Air Force Logistics Command (AFLC) initiative to modernize the maintenance and repair facilities in the command. Within OOALC, the Industrial Products and Landing Gear Division (MAN) was chosen as a prototype for the installation. The utility of MRP II at the ALCs will be evaluated in great part based on the success at OOALC, MAN in particular (17:64).

MAN is scheduled to "turn-on" closed-loop MRP during the summer of 1989 with the other two divisions, the Aircraft Division (MAB) and the Missile and Aircraft Systems Division (MAK), to follow at six month to one year increments. The total cost for MRP II installation at OOALC will be $17 million (17:64).

Once OOALC is complete, the other Air Logistics Centers (ALCs) will follow Ogden into implementation over the next 12 years. A network of depots using MRP could result in a tremendous increase in productivity, providing substantial savings in terms of depot level repair and maintenance cost (39:63). MRP II could also serve to improve force readiness by shortening the time aircraft and parts spend in depot, through better scheduling of the work and fewer delays while in process (41:19-26; 38:11).

However, these potential improvements come with a big price tag, over $200 million for implementation at all five ALCs (17:64). The size of the project makes it a prime target for budget cutters. Consequently, if OOALC implementation is not successful, the whole MRP II project within AFLC may be in jeopardy.

Problem Statement

The research problem has three parts. First, the evolving nature of MRP II implementation within MAN needs to be studied and analyzed because of the pivotal importance this organization plays in the overall AFLC implementation effort. Secondly, the impact of OOALC's experiences on the organizations following it into implementation is significant, because contract constraints will limit the amount of outside education and training available and place

a greater burden on the lessons learned during previous implementations. Finally, the likelihood of successful MRP II implementation throughout AFLC will be determined in large part by the experiences at MAN and OOALC. Addressing the research problem requires a series of investigative questions to guide the research.

The first investigative question seeks to determine the current status of MRP II implementation at OOALC. This part of the study will look for specific strengths or weaknesses within the organizations, providing a snapshot of the implementation process.

The next investigative question addresses the lessons learned during implementation. To answer this question the research will examine the procedural changes over the past year. This question will examine the problem areas addressed during last year's study. Determining the progress made on identified problem areas will facilitate answering the research question.

The degree to which the OOALC implementation complies with accepted procedures in the literature will serve as a predictor of eventual success. This is the third and final investigative question.

Scope of the Research

This is essentially a case analysis of a particular aspect (MRP II implementation) of two closely related organizations (MAN and MAB). This method of study focuses the research, concentrating study on the interactions within the organizations (15:61).

The study of MAN, MAB, and the AFLC-wide implementation process will be a snapshot of the current state of the systems. As such it lays the groundwork for subsequent longitudinal studies, just as this research is following a previous thesis on the MRP II implementation at MAN (17).

This research will not judge the propriety of the decision to use MRP II in the repair environment of the ALCs. Rather, since implementation is a given, it will concentrate on the probability of success and ways to improve the chances of success.

Background

As previously mentioned, this research follows the study of MRP II implementation in MAN conducted by Major Michael Finnern in 1988 (17). In his thesis, Major Finnern examined the fundamentals of Material Requirements Planning (MRP) and MRP II to lay the foundation for his work.

Additionally, Major Finnern identified strengths and potential problem areas at MAN through a series of

interviews. He found the project had strong management support and that MAN had received an extensive initial educational program. But he also identified some potentially threatening situations. While the initial education was good, the subject of continuing education had yet to be resolved. Additionally, it was emphasized that no pre-contract-option education is allowed at the subsequently implementing organizations. Therefore, the ALCs to follow will not have the advantage of MAN's running start when they begin implementation (17:68-79).

Another potential problem area identified in the original study was resistance to change within the organization. Evidence indicated that resistance increased the further down the division hierarchy it was studied. Major Finnern drew a link between heightened resistance and lower MRP II educational levels (17:68-79).

MRP II implementation has been examined extensively in the private sector. MRP II is a fast growing part of industry's efforts to increase competitiveness (3:1). Many sight the benefits of success, including tremendous savings in operating costs (38:41-44; 3:63-64), improved moral in the work place (21:47), and increases in customer service (41:20).

However, in addition to the benefits, inherent dangers are associated with MRP II implementation. Among these are

expense, which can be a staggeringly high figure. This is especially true when all of the money must be committed before any return is realized (41:27-35; 40:353-359). There is also an element of risk associated with MRP II implementation. The overwhelming majority of those firms attempting MRP II fail to reach Class A status (8:15; 12:386). Those attempting implementation find it is very resource demanding, requiring not only committing some of the firms best people to the project, but also the energy and enthusiasm of the entire organization (38:14, 88-89).

Definitions

The vernacular of MRP II is fraught with industry peculiar terms. To assist the reader, a glossary of these terms is provided in Appendix A.

Summary

This chapter has described the general issue of MRP II implementation in AFLC with particular emphasis on the important part that OOALC will play in the future of that implementation. The research problem was also defined and the investigative questions necessary to resolve it were discussed. The background to the problem, particularly the areas highlighted in a previous study, gives added dimension to the problem.

Sequence of Presentation

Chapter II is a review of the literature in three parts, examining MRP in a general sense, a study of the machinations of implementation, and finally discussion of the most vulnerable aspects of an MRP II implementation. Chapter III presents the methodology of this research, which is a case analysis using both interviews and a questionnaire. The relative merits of these two methods are assessed and steps to avoid possible disadvantages are discussed. Chapter IV analyzes the primary data collected for the study, and Chapter V completes the research with conclusions and recommendations.

II. Review of the Literature

Overview

This chapter presents a review of literature germane to the research. The information presented is designed to add depth and provide a baseline for the analysis of data in Chapter IV. This chapter will have three parts: 1) MRP Principles, describing the key components of an MRP system; 2) Basic Implementation, describing the path to successful implementation drawn from the literature; and 3) System Vulnerability, addressing and summarizing the key contributors to implementation failure.

MRP Principles

In researching the topic of MRP it struck the author that, for the most part, MRP is based on very simple common sense principles and techniques. It is possible to apply these principles to a variety of situations (30,13). This section will examine the basic concepts of MRP and conclude with a discussion of the expected benefits of a successful MRP installation.

Basic Concepts. MRP can be summarized in one phrase: Having the right resources at the right time (33:69). Resources include parts, components, raw materials, labor,

and facilities. The right time means having those resources when needed to meet the production schedule. A closer look at each of these elements will reveal the basis of MRP operation.

Right Resources. The resources required for manufacturing a product are defined by the bill of materials (BOM) and bill of labor (BOL) (28:204). These bills, when used in an MRP environment, are constructed in a hierarchal fashion, forming a tree. The tree has the end item at the top level, level zero. The next level, level one, consists of the components, materials, labor skills, or tools necessary to complete the end item. This pattern continues down the tree until the final level is reached, consisting of raw materials or basic purchased components (28:49-52).

In MRP, the BOM must reflect the manufacturing process. This requires the various levels to be both sequential and prerequisite, reflecting the way the item is manufactured (27:35). In this way, the BOM defines the way materials flow into and out of stock, with stock being a particular state of completion (29:17). The BOL is parallel to the BOM, but rather than components it describes the necessary manpower, tools, and equipment required for product construction.

The BOM and BOL are used to determine the necessary resources at each stage of the manufacturing process. The

product bills are 'exploded' to determine the number of subcomponents needed for assembly at any particular level (25:459). This is also where lead time enters the process. Lead time phasing will be specifically addressed later in the section.

The BOM is a critical input to the MRP system, describing what is needed to construct the part. But the system also needs to know inventory availability before it can plan production of the end item. Having the right part on hand is a function of inventory planning, which can be done in one of two basic ways, either reorder point (ROP) or requirements planning (30:13). ROP uses an estimated demand over lead time to determine when inventories need to be reordered (30:13). This type of system is unable to determine the exact timing of needs and consequently requires carrying excessive inventory levels to compensate for variability of demand (28:5). Additionally, the ROP system treats each item's demand separately, requiring individual forecasts of demand (27:31). ROP is appropriate when the demand for a product, item, or component is independent of any other products, items, or components, such as end items. End items experience independent demand, since their demand is not dependent on demand for higher level items (19:11).

In manufacturing, however, demands for lower level items are dependent on the demand for higher level items (30:13). For example, if component A is made from two part Bs, then the number of Bs needed will be dependent on the number of As required. Any demand for Bs comes strictly as a result of the demand for As. In this way the dependent demand for B faces no uncertainty, every A produced will require two times that number of Bs.

MRP is ideally suited for use with dependent demand items (19:11). The system will match the lower level dependent demand defined by the BOM with inventory levels. When inventory levels are inadequate to support production, the system will alert the inventory planners of the requirements (9:293). With this type of inventory planning and management, the inventory levels can more reasonably match the production requirements of dependent demand items. Since only end items face an independent demand, inventory planning for the vast majority of parts can use requirements planning.

The concept of independent and dependent demand is critical to MRP operation (19:11). Plossl and Wight called it the "single most important inventory principle that has been developed" and also that it "helps to clarify the confusion about where to use order points [independent demand items] and where to use requirements planning

[dependent demand items]" (30:12). Additionally, MRP proves to be a better planning system, when available, because time phasing is included in the process (30:12).

Right Time. Time phasing sequences part requirements for assembly. Having parts when needed is critical for dependent demand planning to work properly. The 'when' is determined by the BOM in conjunction with the master production schedule, or MPS. The MPS is a detailed manufacturing plan that includes all independent demands, both end item and service part, and defines the time when production needs to complete assembly to meet end item delivery times as specified in the production schedule (28:237). The MPS defines what reasonably can and will be produced, based on the firm's production plan. After receiving the MPS input, MRP time phases inventory planning by accounting for the different lead times associated with the various components of an end item (28:268-269). MRP works backwards from the end item due date. For example, end item A is due out in four weeks and is composed of subassemblies B and C, with lead times of one and two weeks respectively. If final assembly of A takes one week, then subassembly B is not needed until week three and consequently will not be ordered until week two. Subassembly C is also required in week three for final assembly, but since it has a longer lead time it must be

ordered in week one. In this way MRP minimizes inventory levels while concurrently providing feedback about the reasonableness of the production schedule. There is no benefit to having either subassembly before it is needed (30:14).

While there was sufficient time to comply with the schedule in the previous example, consider the outcome if subassembly C required four weeks instead of two. The earliest item A could be available would be week five. In that case item B would not be required until week four and need not be ordered until week three. In this way the MRP system can deexpedite the requirement for item B. Deexpediting effectively lowers the priority of an item when the complementary items necessary for next level assembly are not available (30:16). If there were additional levels in item A's BOM, this same pattern would continue until reaching the lowest level raw material or purchased part. Consequently, using MRP, inventory is ordered only when needed (32:62).

Deexpediting reduces unneeded stress because unneeded parts are not hurried through the manufacturing process only to sit and wait for other parts. Deexpediting improves overall performance in two ways: first, lower inventory levels; and second, improved employee productivity and morale by eliminating the "hurry up and wait" syndrome,

producing a part under pressure only to have it collect dust waiting for other parts (21:28;32:65).

The MRP output is dependent on the MPS, BOM (and BOL), and inventory status. The MPS is derived from the production plan, which identifies the resources and production rates required to support the financial and sales plans. The MPS is therefore the management input to MRP (29:15). The specific master production schedule stipulates the end item quantities and timing. The MPS is input to the material requirements planning system and compared with the bills of material and labor in addition to current inventory levels to determine the amount needed and availability. Orders for subassemblies, components, and parts are time phased down the BOM using the various lead times for each item. The MRP output will define not only a precise production schedule but also plan the inventory levels necessary at any point in time. This section has described the basic mechanics of MRP, the next section will discuss the benefits of a successful implementation.

Benefits. MRP provides more timely information to management by virtue of automated integration of the business plan inputs, which translates directly into improved customer service (22:88). There will be fewer late orders due to stockouts, since inventory levels are directly

related to production and shortfalls are spotlighted by the system early enough to allow replanning (30:15).

In addition to improving service, operating costs are reduced. These savings are derived from the reduction in time spent waiting for the proper parts to complete a job. Reduced idle time translates directly into higher productivity (21:48). Having the necessary parts also avoids substituting higher priced parts or paying premium transportation fees to expedite deliveries (36:25).

Perhaps the greatest savings comes from the reductions to inventory for material requirements planned material (28:8). Inventory holding costs are non-value adding, since having a large inventory does not improve the product in any way. By having the right parts at the right time and not before, inventory levels are reduced and the costs associated with holding inventory are either eliminated or dramatically reduced. Holding costs include capital, storage, and risk. Capital costs are those associated with investing in inventory instead of something else. Since inventory does not produce revenue while held, investment in any revenue producing enterprise other than held inventory is preferable. Storage costs include the heat, power, light, security, handling labor, and clerical record keeping. Risk costs pertain to the dangers of obsolescence, deterioration, pilferage, and damage (25:629).

MRP also lets managers manage. With MRP acting as the corporate game plan, managers are faced with fewer crises demanding their immediate time and energy. They are freer to plan for the future and prioritize the present (42:84).

The expedite-deexpedite feature of MRP allows planners to keep priorities straight. As discussed earlier, when an item cannot be completed as scheduled, there is no reason for complementary components to continue through the system with the same priorities. Instead, their priorities can be reduced to allow processing of other parts, improving overall productivity (26:87).

Finally, long range planning is improved as a result of MRP's simulation capabilities. Running a proposed production plan through the MRP software projects the likely impact of a particular course of action. This "what if" capability multiplies management's ability to manage the firm (26:85).

Summary of Basic Principles. The principles of MRP are not difficult to understand. Integration of the various business activities into a single plan makes good sense in terms of maximizing productivity. The reason MRP has surfaced only relatively recently is due to the need for computers to perform the multitude of calculations required (33:69).

As Oliver Wight said:

> To do requirements planning manually ... would require a staff about the size of the Chinese army plus a year's output from the Eagle pencil factory. (38:144)

The principles of MRP are just applied common sense. Computer technology has progressed to the point that it is no longer a limitation on applications of the system.

The common sense principles and available technology seem to run counter to the meager five percent success rate [Note: the author uses Class A or B operation as a measure of success, see Appendix D] experienced in industry applications (12:386). Since the design of MRP seems sound, the only remaining suspect is execution. Examining the path to implementation will increase awareness about the difficulties experienced in the execution phase of MRP.

Basic Implementation

Implementation of an MRP system requires three prerequisites: need, commitment, and a plan. Need is the impetus for changing from the current method of doing business to using MRP. This usually comes as a result of a firm losing money, falling behind competitors, or facing the threat of falling behind competitors. This impetus can then be linked to a goal for implementation, defining what is expected and when it is needed (20:185).

Commitment to the project is necessary at two levels, both management and labor. To succeed, implementation needs to be the second priority, right behind running the business (38:14). It therefore involves top management's direct support and involvement. Labor support and involvement is also necessary because implementation will change the way business is done, and a corresponding change in worker behavior will be necessary (21:49). The energy required of both management and labor are valuable assets of any organization. To ensure it is used wisely, an implementation plan is critical (2.62;38:15).

The plan is a path to follow delineating the tasks and milestones necessary for efficient, successful implementation. The rest of this chapter will examine a generic path drawn from the literature. While relying heavily on the chronological framework provided by Wallace (38:37), other sources are used to add depth or present alternatives.

The Path to Implementation. First and foremost, implementation is a lot of work and a do-it-yourself project (20:196;38:13). It involves education, training, new hardware, different types of data, and new policies and procedures. But even with this significant array of requirements implementation cannot become the top priority of the organization, which must remain the running of the

business. After all, MRP is designed to improve the operation of the business, not the other way around.

Secondly, implementation is people intensive. MRP is not a computer system, it is a management and planning system facilitated by computers (38:14). As such, implementation will involve all departments in the organization. Since the way business is done is changing, everyone involved in the business needs to change as well (20:185).

Because implementation requires so much energy, it is important to limit the duration of the process as much as possible (34:301). Accounting for various levels of preparedness, the procedure should take from one to two years (20:196;38:16). As the time to implement increases, the probability of success decreases. The enthusiasm is difficult to maintain and implementation must compete with other projects and initiatives to maintain its high priority (20:196-197). A tight schedule is less likely to slip, assuming implementation holds a very high priority in the business, and a faster implementation will accelerate the realization of benefits (20:197).

Wallace's path to implementation provides eleven steps to follow in a chronological order (Appendix E). The subheading for each step is followed by the initiation and completion time, in months, suggested for a particular step.

First-Cut Education: 0-1. Senior executives and managers should receive the initial battery of MRP education. This education will tell them what MRP is, help them estimate how much it will cost, determine the likely benefits, and decide whether it is right for their firm (38:36). First-cut education is prerequisite to the next step on the path.

Justification, Responsibility, and Commitment: 1-2.

Justification. Justification involves determining the cost to benefit ratio of implementation. During this phase the numbers used to make the go or no-go decision are developed (38:38). There are three cost categories plus contingencies that need to be considered. It is recommended that 10 to 15% of implementation costs are allocated for contingencies (20:194). The three cost categories are automation, data, and people.

The costs of automation include hardware, software, and systems personnel (38:38). These costs can vary significantly dependent on the current level of automation, its applicability to the new system, and the level of systems personnel training necessary for installation (38:39).

Data costs include the costs of attaining the inventory and BOM accuracy necessary for MRP to function properly. These are discussed further in a subsequent section.

Additionally, the costs of forecasting, item data, and work center data must be considered (38:40).

The final category, people, includes many different costs. The project team requires a full time Project Manager and perhaps one or several full or part time members (20:187). Education and training could be a substantial cost, dependent on the number of personnel involved. These costs should also include travel, lodging, and lost working time for all projected education and training sessions.

Although MRP implementation is a do-it-yourself project, consultants may be needed during the implementation process and their cost should be included (5:109;20:190). Additionally, any new indirect labor positions required, such as master scheduler, materials planner, or more dispatchers, should also be included (38:40).

The cost of implementation is high. The average company can expect to spend around one million dollars (38:41). A 1984 survey of MRP users found the average total cost to be about $900,000 (2:53). Interestingly, the cost for Class A implementation was not significantly different from that for Class D (38:41). Again, the difference between success and failure seems to lie in execution rather than with resources or basic MRP system design.

Computing the benefits of implementation is more varied and less concrete, since the future can be difficult to

quantify. There are many benefits derived from a successful MRP implementation, enumerated in the Basic Principles section earlier in this chapter. First among these benefits is improved customer service. MRP will improve a firm's ability to deliver on time and shorten the lead times for customer orders. An average firm can expect a 16-28% improvement in this area (38:42).

Productivity should improve about 10%. This improvement comes from reduced idle time waiting for parts, reduced expediting, and less overtime because of improved forward visibility (38:42).

Purchasing costs should decrease 7-11% because the firm can provide vendors with a valid, consistent schedule (38:42). This predictability and dependability will not only improve inventory planning, it will make it easier for vendors to meet the firm's schedules, because they can count on the orders (6:34).

Inventory could provide the greatest single source of savings, with an estimated 17-25% cost reduction. The threat of obsolescence will be reduced by a combination of shortened lead times and the ability to phase-in engineering changes to coincide with stock depletion (38:43).

Since priorities are continuously controlled, an end-of-month surge to meet due dates is less likely. This improves quality by eliminating the 'quota rush' (38:43).

An improvement in job satisfaction and employee moral is a qualitative improvement almost impossible to measure but none the less valuable. It comes as a result of allowing people to spend their time doing their jobs instead of responding to emergencies (21:48).

Responsibility. The success or failure of the project should be directly traceable to those responsible for the implementation decision. This ensures that the "sellers" of the MRP II project are conservative in their estimates of success and will tend to err on the conservative side. This conservative tendency will improve the likelihood of success if implementation is pursued (38:44).

Commitment. The decision to implement the system should be based on the following two questions: 1) Does the computed cost to benefit ratio justify making implementation the number two priority of the business?; and 2) Can the organization maintain implementation as the number two priority for the time required to complete it? Only if both questions are answered positively should the organization commit to an MRP implementation effort (38:56).

> Successful MRP systems require a commitment to concept, a commitment of management, and finally a commitment of resources and dollars. (2:62)

Initial Education and Training: 2-8. As stated by Dr. W. Edwards Deming:

> Long term commitment to new learning and new philosophy is required of any management that seeks to accomplish anything of note... the timid and the faint-hearted, and people who expect quick results without effort, are doomed to disappointment. (23:211)

Education and training are critical to successful implementation. There are two basic objectives during this phase: fact transfer and behavior change (12:387).

Fact Transfer. Fact transfer is basically just explaining the what, why, and how of MRP operations. This is the lesser challenging of the two objectives (38:82).

Behavior Change. Behavior change occurs when people are convinced of the need to do their jobs differently. The criteria for convincing them are many and varied. First, top leadership involvement in the education process is important. Employees will respond more positively to a program when they can follow the example of their leaders, whose involvement adds credibility to the entire project (8:17).

For the education process to succeed, a specific group of people need to be held accountable for program success. This group should include all of the department heads, since they know how the business is being run now, how it needs to change under MRP, and possess the authority to make the

required changes. Holding them accountable improves the likelihood of success at the operational level (38:87).

But first the department heads need to undergo the change process themselves (20:195). An intense battery of education will help, coupled with the support and commitment of top management (22:284).

The body of people requiring education must include all those employees whose behavior must change (34:301). Since MRP is a new way of doing business, this includes virtually everyone in the organization (24:81). If MRP is to succeed, a "critical mass" of educated employees is necessary. In most companies this means educating "80%-minimum-of all people in the company" prior to implementation (38:88). The critical mass must believe in the MRP process to facilitate the behavior change needed. This will build inertia within the organization encouraging compliance and even growth within the system.

The importance of the behavior change cannot be overstated. Again, MRP is more people intensive than technical (21:49).

Once the initial education process is complete, continued reinforcement is necessary (31:46). This will help in two ways. First, it tells the employees that MRP is still important to the organization and not just a one-time, gold-plated management program. Secondly, it allows the

principles to soak in over a longer period of time. The longer time frame encourages people to question the material as it is encountered on the job and then return for answers and reinforcement.

Enthusiasm for the project should grow when employees begin linking their problems to MRP solutions. This enthusiasm is needed to provide the energy necessary to complete implementation (8:15).

Data Accuracy: 2-8. Data accuracy is another critical element to MRP operation. Within this category there are two key elements: Inventory and BOM (14:289;38:109).

Inventory. Inventory levels should be at least 95% accurate (5:110). This is accomplished using four methods, all of which require behavioral change to succeed. First, the supply personnel need to know their importance to successful operation of the system (34:301). This will provide the impetus for maintaining the required discipline in recording transactions, which is the second method (36:24). Recording every transaction is obviously important to maintaining accuracy. The simpler this process is the better the system will work (6:33). Finally, limit access to the supply center. This will not only keep others out, it will "keep accountability in" (38:113). Once established, the system should use cycle counting to maintain accuracy (38:84).

Bill of Materials. BOM accuracy needs to be at the 98% level (20:190;38:119). The bill must be complete, since it provides the blueprint for the entire MRP process (29:15). One way accuracy can be checked is through a floor audit, with engineers comparing the actual product with the BOM. The check may involve tear-down, disassembling the product, and comparing the parts to those called for in the BOM (29:17).

Production Planning and Master Production Schedule Policies: 3-8. Production planning should start as soon as possible in the process. Since it is normally done only once a month, the opportunities to learn by doing are limited prior to "turning-on" the system (6:33). Exercising the opportunities to practice will improve actual performance and will also serve as an example to others in the organization. Demonstrating management's resolve to learn about and use the system will improve the entire organization's sense of commitment.

At this point the role of the master scheduler should be defined to demarcate the lines of authority for making changes inside the time fences (28:133). Time fences are used for planning production demand and come in two basic varieties, demand and planning. The demand fence sets the time period inside which only actual orders will be used, excluding forecast orders. The planning fence defines the

time period inside which the MPS will not be altered automatically by the system, usually corresponding to the cumulative lead time for the production process (35:108-109).

Systems and Software: 3-8. The equipment and peripherals should be procured after learning more about the firm's particular needs (38:140). Tested software is usually the best, a package previously implemented by a Class A or high B user is preferable. Since any system will require some tailoring, selection of the most basic system available meeting the company's minimum requirements is recommended (7:102). Another consideration should be the ability to interface with any presently existing systems planned to remain after MRP implementation.

Live Pilot: 8-9. The live pilot is a dress rehearsal for company-wide implementation. It is designed to test and prove the system on a small scale, facilitating problem analysis while refiring enthusiasm within the organization (18:305;38:154-155). The segment of the product line chosen should be self contained to the greatest extent possible, minimizing the effects of off-line systems on pilot operation (38:162). Once the pilot is successful, the implementation can progress to cutover of the entire production process.

Cutover: 9-12. Cutover involves converting the remaining processes to the formal MRP system. This can be done incrementaly, using product groups, providing the same advantages offered by the pilot (38:165).

At this point the MRP system will be operational. A formal feedback system does not yet exist, so some dedicated shop personnel will have to act as the eyes and ears of the system until the loop is closed in the next phase (38:165).

Closing the Loop: 12-15. This phase formalizes feedback in the system. It includes shop floor control, capacity requirements planning, and input/output control.

Shop floor control involves communicating changing priorities to the shop floor. Capacity requirements planning (CRP) will provide a more detailed analysis of the firm's capability to meet the MPS after MRP integration (38:173). Input/output control tracks actual performance compared to planned performance, enhancing process problem diagnosis.

Closing the loop should have its own pilot to test the shop floor control activity and validate the procedures, transactions, education, training, and software (38:177). This pilot is designed to work just as the initial pilot did, surfacing problems or identifying potential problems prior to inclusion of all products (34:301).

The cutover to closed loop will involve bringing CRP on line and learning to read its output. This subsystem may require extensive fine tuning and should not be interpreted too literally at first (38:177).

Communication is perhaps the most important part of the closed-loop cutover (38:177). There will almost certainly be problems needing resolution, which should be expected in a project of MRP's magnitude. But the problems cannot be resolved unless people talk about them and determine the cause.

Purchasing and Vendor Scheduling: 14. After closing the loop, the next step involves expanding the scope of the system outside of the company to include material procurement (37:73). The MRP system will help the buyers by improving their look-forward capability and allowing them to establish long term contractual relationships with vendors (37:71,73). They will also be able to provide the vendors with weekly schedules, improving the vendors' ability to predict demand, and hopefully to reduce variability in service and cost (38:178).

Finance and Simulation: 15-18. Finance and accounting training and involvement should not wait until this point, rather they should be involved as early in the process as possible. They will need time to align record keeping with the new system to allow it to handle the new data required

for system operation (38:184). Financial data will be one of the key inputs to the MRP system, providing constraints and recommendations about production, procurement, and capacity.

The simulation capability inherent in the system will lend itself to many management applications (35:116). It will allow management to experiment with possible alternatives to the process without the risks or expense of actually changing it (33:71). Like most simulation models, confidence increases with greater use and success (11:5-1).

System Vulnerability

The execution plan shows MRP to be far more intricate than the basic principles might suggest. This section examines more closely the potential problem areas associated with MRP implementation.

People. The major impediment to successful implementation comes from the people side of the process. According to Orlicky:

> The most serious obstacles to MRP systems success lie outside the system boundaries. The problems must be sought not in computer hardware and software but in people, their attitudes, habits, and knowledge level. (4:56)

The process of implementation must be a do-it-yourself process, requiring mastering of people skills for successful implementation and operation of the system (21:47).

Education and Training. A major stumbling block to successful implementation is often inadequate or incomplete education and training. Sometimes not enough people are educated, considering the universality of change to the business operating environment (8:17).

Training is often accomplished by outsiders unfamiliar with the inner workings of the business. This can be extremely detrimental, because training needs to be at the "how to" level and should present specific actions, reactions, and expected situations to the trainee (31:46).

Bad Data. As stated earlier, BOM and Inventory accuracy need to be at the 95 and 98% levels respectively (5:110;29:15). If not, the integrity of the MRP system output will deteriorate steadily until it is no longer credible (32:64). Bad data makes it impossible to complete the master schedule, and the operation will soon degenerate to the old informal system of hot sheets for expediting (24:81;34:301).

For MRP to operate, all elements must work together. It is appropriate to consider the MRP "chain" only as strong as its weakest link. If one element is failing, it will erode the capabilities of the entire system (36:26).

Management Involvement. Most failures can be attributed to a lack of management involvement and poor employee attitudes toward the system (8:15). To succeed,

management must consider implementation a high priority goal of the firm and just as importantly they must communicate this commitment to the entire organization (20:196).

Timing. The duration of the implementation process seems to be a very significant predictor of project success (20:196). The longer it takes to complete, the less likely it is to succeed. This correlation seems to be more symptomatic than causal, with long implementation times resulting from failure in one of the other aspects of implementation. Too low a priority, poor communication of management commitment, and inadequate education resulting in lethargic behavioral change are all possible causes of extended implementation.

Summary

This chapter has examined the basic principles of MRP and described a path to implementation. It has shown the common sense basis for MRP logic while at the same time examining the very complex procedures required for implementation. The chapter concluded with an examination of the likely pitfalls to successfully implementing an MRP II system.

This information will be used to highlight and contrast the primary data analyzed in Chapter IV. Together, Chapters II and IV will serve to answer the research questions

presented in Chapter I.

The methodology for answering the research questions as well as a discussion of capabilities and limitations of the techniques chosen are presented in the next chapter.

III Methodology

Overview

A case analysis methodology was chosen to study the MAN implementation and to infer the probability of project success, both in the remaining OOALC divisions and at the other ALCs in AFLC. This methodology is well suited to the study of one unit for comparison over time (13). It uses primary data obtained from either survey or observation of the unit to make inferences about causation of problems within the organization or generalizations about like organizations experiencing similar circumstances.

This research used two survey techniques to acquire the primary data needed for the study, personal interviews and a questionnaire.

Methods

The investigative questions were addressed using a combination of personal interviews and questionnaire results. Interviews provided the preponderance of data concerning addressing problems identified last year.

Personal Interview. The personal interview is considered the best survey technique when reasonably available (10:101). Interviews have particular utility when the required information is held by other people in the form

of opinions, attitudes, intentions, or expectations (15:159).

The same interview instrument applied last year during Finnern's study was used with only slight modifications. The interview instrument is in Appendix B.

Since the aim is to look at the change in opinions, attitudes, etc., it is important to be consistent in the interrogative instrument. To this end the interviews will parallel the previous interviews in terms of subject duty position, type, and location.

Major Finnern interviewed a cross-section of people involved in the MRP II implementation, not only at Ogden, but at AFLC Headquarters as well. This included Project Team members, division chiefs, unit chiefs, and branch chiefs. In fact, the interviews conducted during this study used some of the same people as the previous study.

The researcher considered it important to get both a breadth and depth of information in the interviews. This was possible, because the subjects on the implementation teams at the ALC not only represent the project offices, but also have extensive experience in ALC activities. Breadth was considered necessary to avoid a biased, parochial set of responses. To ensure a wide variety in the interview sample, a cross-section of specialties were interviewed, including some random selections while touring the

production facilities. Depth was achieved through interviews in the project offices, concentration on those most familiar with the topics of the interview, MRP II implementation. The interviews were face-to-face, conducted at Ogden for the OOALC personnel.

The interview instrument is divided into six separate categories: Management Support, Education, Project Implementation Team, Change Management, Data Accuracy, and Pilot Project. This categorization facilitated concentrating questions based on the interviewee's background and expertise. An additional benefit was the grouping of responses for analysis in Chapter IV.

Interview Justification. The interview method offers several advantages. First, it provides more complete information because the interviewer is present. This presence allows for follow-up and probing questions in reaction to subject response (10:100). Secondly, the interviewer can insure completeness of the instrument by virtue of administering it himself. Before concluding the interview a quick glance over the instrument will indicate whether all of the questions were asked and answered (10:100). Physical presence of the interviewer also allows subjective judgments of the interviewee. Impressions about the confidence, honesty, or interest of the subject can be

used to weigh the information obtained in the interview (10:100).

There are several disadvantages to interviewing. These will be discussed along with steps taken to minimize their effects. The first and perhaps major disadvantage of the interview is the expense involved. It is expensive in terms of man-hours, transportation, and living expenses (16:210). To reduce the effects as much as possible, all interviews at off-base locations will be prescheduled to avoid unnecessary waiting and the possibility that the subject is unavailable. In this vein every effort was made to limit the number of Ogden ALC visits to one.

A second disadvantage of the interview method is bias. According to Ferber and Verdoorn there are many types of bias related to interviewing, several of which will be addressed here (16:232-236).

Non-responsiveness bias occurs when a subject feels threatened by the interviewer or the interview topic. The subject may also feel too busy or uninterested in the interview topic. The only answer to this problem lies with the interviewer himself. By making appointments, the "too busy" problem should be avoided. Since this is a follow-up to a study that received cooperation, the problem of motivation should be minimal. Additionally, the emphasis of the research and the interviews will be "help" oriented,

designed to use the subject's expertise and knowledge of the topic area to help others. This should relieve any threatened feelings as well as increasing their motivation.

Another type of bias is inadvertent misrepresentation. This can result from a variety of causes. The interviewer may shorten a response during its recording, deleting an important qualifier or expansion. Also, the subject may be misinterpreted and then paraphrased out of context. To avoid these two situations the interviews will be tape recorded, with the subject's permission. The interviewer could also simply not understand the answer given. This problem can be countered with follow-up and clarifying questions.

Identification bias is a third type of bias encountered when using interviews. This occurs when the subject is afraid of being identified with her comments and reverts to the "company line" to avoid possibly unfavorable repercussions. A guarantee of anonymity may or may not answer the problem. If not, probing questions and a subjective appraisal of the response value are the only alternatives.

When the interviewee is aware of the research topic, his answers may be influenced by what he thinks the interviewer expects. In an effort to make themselves and their work seem important and relevant they may slant their

answers. By emphasizing the potential of this research to help them and others like them and underscoring the importance of candor to that end, it is hoped that this type of bias can be avoided.

Finally, bias can result simply from the way a question is phrased or read. This is called inflection bias, and the interviewer hopes to avoid this problem through extensive practice in administering the instrument.

The results of the interviews were compared with last year's responses (17) as well as with one another in hopes of defining trends, conflicts, agreement, or disparity between the groups. This information can then be applied to the first two investigative questions in an effort to answer the research problem.

Written Questionnaire. A written questionnaire supplements the interviews. The questionnaire was designed to provide additional objective input on those specific areas of overlap between the interview instrument and the questionnaire. Additionally, the questionnaire will be the primary source of data for determining the likelihood of successful implementation at OOALC.

The questionnaire consists of 76 questions divided into 4 categories with 2 demographic questions. The demographic questions identify the respondent by organization and duty position (manager, user, systems). The four categories are:

Management Support, Understanding of MRP, Impact of Implementation, and Prediction of Success.

The questionnaire was used because again the data needed is primary and held by people in the form of opinions, attitudes, intentions, and expectations. However, answering these questions will require responses from a larger sample of people, including shop floor personnel. It would be prohibitively expensive and time consuming to interview the two-hundred or so people needed and then analyze the voluminous qualitative data generated. To provide the broader, deeper representation of the organization, a written questionnaire will be used (16:210).

The questionnaire in Appendix C was administered to a sample of HQ AFLC, MAN, and MAB personnel. The sample included personnel in the following areas at the ALC: Production-Shop Floor; Scheduling; Material Support; Engineering/Planning; MRP II Project Teams; Operations Training; and Division Management. The questionnaire was adapted from the one appearing in Clark (8:20-34). The reader should note that the original six-point Likert scale was retained. There were two reasons for not changing to an odd numbered scale. First, comparisons to other uses of the questionnaire would be less meaningful if a different scale is used. Second, the type of information sought is subjective, and using an even numbered scale forces the

respondent to either agree or disagree with the statement. The researcher felt the responses would provide a better indication of the current situation if the respondents were forced to choose.

The questionnaire will be submitted to all levels of the organization, not just those associated with the MRP II implementation plan. In this way the researcher will be able to determine the extent which MRP II has permeated the organization and also elicit subjective appraisal of the system by those most affected.

The same questionnaire will be administered at MAN and MAB. Since they are at different levels of development their responses are expected to vary greatly. There is no intention to consider them part of the same population, but a comparison of their general attitudes and expectations may serve to identify symptoms of problems. This was done using descriptive statistics. Comparison of attitudes between different groups within each organization was accomplished using analysis of variance. The questionnaire also lays the foundation for a subsequent longitudinal study of the organizations' attitudes.

Grouping questions into the four categories requires use of two methods. First, the researcher analyzed the questions logically to determine their most likely placement. Once the questionnaires are complete, a Chi-

Square test for goodness of fit will be conducted to determine statistically the questions corresponding most closely with each category's key question. This process will use the Crosstabs command of the SPSS-X statistical analysis program.

Analysis of the questionnaire results will use descriptive statistics to compare and contrast responses to categories as well as individual questions. Mean responses will be the primary tool, supplemented as necessary by mode and standard deviation results.

Statistical analysis should identify trends and conflicts. These tendencies will be analyzed two ways: first, within the results of the questionnaire itself; and second, in contrast to the interview results.

The questionnaire categories overlap with four of the interview categories: Management Support, Education, Project Implementation Team, and Change Management. The Management Support category overlaps directly between the interviews and the questionnaire. Comparisons can be made in three ways within this category: by category, by individual question, and by contrast with the interview results.

Education can be addressed using the Understanding category of the questionnaire. Contrasts by organization and duty position should add to the information gained and the perceptions realized during the interview process.

Additionally, within the Understanding category is a specific question about the continuing education program (question 46) which can be used individually.

The Project Implementation Team category has no direct analog in the questionnaire categories, however several of the individual questions relate directly to the teams. These questions (26-28, and 35) can be analyzed using both the organizational and positional variables.

Change Management is related to both the Impact of Implementation and Likelihood of Success categories of the questionnaire. Analysis of responses by both position and organization will add another dimension to the data generated by the interviews.

The questionnaire responses themselves should surface similarities and differences between the various sub-groups in the population. The analysis of variance and Tukey tests will separate the groups with statistically significant differences in responses to either individual questions or entire categories.

As a predictor of success, the questionnaire responses will be combined with interview responses for analysis and application to Wight's ABCD Checklist in Appendix D. This, along with comparison to the hurdles to success identified in Chapter II will form the basis for answering the investigative question concerning project success.

Questionnaire Justification. The questionnaire offers several advantages in addition to those already mentioned. The cost per respondent is much lower than for interviews (16:210). The data generated is in a quantitative form. An OPSCAN computer scoring sheet will be used to facilitate compilation of the data. Once in a single data base, the information can be analyzed with the statistical program SPSS-X. The anonymity afforded by the questionnaire may have prompted more honest or accurate answers (10:95).

The questionnaire is not without its disadvantages though. The response rate is somewhat beyond the researcher's control and the analysis can only be based on the responses returned (16:210). There is also the possibility of blank or mismarked answers.

Summary

The results of the three survey instruments are analyzed in Chapter IV and will be used to answer specific research and investigative questions in Chapter V. However, the value of the research data will be greater than the sum of its parts due to the overlap in the information generated by each instrument. This synergy will provide an added dimension to the analysis, allowing the combined analysis to present a clear picture of the MRP II implementation. The results will be contrasted with the information presented in

Chapter II for comparison with the recommended paths outlined in the literature (3; 38; and 41).

IV. Analysis of Data

Overview

This chapter compares and contrasts the implementation data generated by the interviews and questionnaire, as outlined in the previous chapter. The objective of this chapter is to explore the data collected and provide a basis for answering the investigative questions presented in Chapter I. The answers to the three investigative questions, concerning current attitudes and beliefs, how problem areas identified last year have been addressed, and prognosis for success, will form the basis for the conclusions and recommendations presented in Chapter V.

The analysis is divided into two parts. First, the research examines the interview data from this thesis and simultaneously compares it to last year's findings as the means of answering the first two investigative questions. The second section will add the quantitative results of the questionnaire to reenforce the interview results and answer the third investigative question.

Interview Results

Twenty-five interviews provide a broad spectrum of data for analysis. As defined by the interview guides, the

questions are divided into six areas: Management Support; Education; Project Implementation Team; Change Management; Data Accuracy; and Pilot Program (Appendix B). Each area is individually addressed in this section, with areas of consensus and controversy highlighted.

The viewpoints of the interview subjects were combined with others in their organization and a consolidated representation of the group is used. Quotations come from the actual interview respondents. These particular quotes were selected because they reflect the character and mood of the responses received. They are shown in quotation marks but without specific citation to protect the anonymity of the interviewee.

The organizations consolidated into three: HQ AFLC; OOALC/MAN and MA-1; and OOALC/MAB. Occasionally disagreement within the groups was noted. When this disagreement was deemed significant it was addressed in the analysis.

Management Support. This area is of particular importance to the success or failure of an MRP implementation, as highlighted in Chapter II. There were some particularly interesting responses to the questions concerning top management support. Within each group there were respondents who felt top level support was very strong. To a person they expressed the criticality of this support

to the overall success of the project. However, within each group there were also respondents who felt top management support was "lacking the necessary ferocity," "politically expedient," or "diffuse." Respondents at the headquarters expressed greater frustration about the lack of support than did their ALC counterparts. It is significant to note that each group has different foci for their evaluation. The ALC groups considered the ALC Commander, OOALC Chief of Maintenance, and the division chiefs as their top level. The headquarters group considered the AFLC Commander, AFLC Deputy Chief of Staff for Maintenance, and the AFLC Maintenance division chiefs as their top level management.

When questioned about specific examples of support or the lack of it, the responses were again predominantly positive. Support for the project has come in the form of letters, verbal encouragement, and allocation of resources such as additional personnel on the implementation teams. The ALC responses were again more positive than those of the headquarters. A particular headquarters response to the questioning of specific support cited an example. "If you ask for more resources the response is: now ask me for something I can help you with." This was not a unique observation at the headquarters. The allocation of funds for education and training materials was questioned repeatedly. The respondents felt that the funding was not

adequate for the education and training requirements and that when they expressed their concern it fell on indifferent ears. The feeling was that top level management either did not understand or did not care about the problem.

The literature cited in Chapter II virtually mandates a number two priority for MRP II implementation if the project is expected to succeed. Each respondent was asked to give their estimate of the current ranking MRP II implementation holds in their organization. Occasionally implementation was ranked as high as second, but the predominant impression was characterized by the response: "somewhere in the top five, it seems to move up or down dependent on what's hot." There are other priorities competing for resources and organizational energy. This is certainly not unusual in any organization, but in this specific case the almost unanimous response placed implementation equal to or below the priority for the AFLC quality improvement program QP-4. Members of the project teams (OOALC/MA-1, MAN-1, and MAB-1) all recognized that many or most of the goals of QP-4 are coincident with MRP II goals. As one team member stated, again uncited to protect the anonymity of the respondent:

> quality improvement is a basic benefit of successful (MRP II) implementation. If headquarters would just get off our backs and realize what MRP will do for them, we could all be better off.

This view was shared in all three project offices. QP-4 was not the only competing priority, but it was universally recognized as the most significant.

Since the project teams expressed concern about management's ability to recognize the parallel benefits of QP-4 and MRP II, the questions on priority were followed-up with questions about management expectations for the implementation. Consistently the respondents said management expected the textbook benefits: lower inventory, shorter flow time, increased capacity, and greater productivity. At the same time there was speculation that management did not really recognize the linkage of MRP II to specific organizational results, such as the effect on a first line supervisor's time and management capabilities. An anonymous team member said:

> They (management) don't know what to expect, because they aren't focused on what MRP can do for them. I feel that's our (the implementation team's) fault for not teaching them properly.

Several respondents expressed concern about management's recognition of what is involved in the implementation process. In many cases, they feel that management expects the MRP II system to overlay the old system with little change to the current operation. This was by no means a unanimous opinion, however. A large number said that management indeed recognizes the significant change MRP II

will have on daily operations. In fact, the division chief of MAB was singled out for his recognition and support of the extensive preparation required for the contractor conducted functional analysis.

The concern for management's understanding of the changes required for implementation was also expressed in last year's study (17:35). Again one of the hypothesized causes was turnover among the military personnel, mandating a constant reeducation process which, as one respondent noted this year, "proves frustrating and time consuming when you consider all of the other things we need to be doing."

Education. Responses to questions in this second section proved far more homogeneous than the first. Everyone recognized the criticality of thorough education to the success of the implementation project.

The major education program at the ALC has been the 144 hour overview class taught by the contractor, Grumman Data Systems (GDS). Weaknesses identified in the GDS course centered around the lack of direct applicability in the subject matter. Students could not see the link between MRP concepts and their daily operations. This link is critical for the production personnel, since large amounts of work in process material have always represented security. If these workers are not properly educated, it was felt, then the overall implementation effort could suffer severe setbacks.

The previous study highlighted two areas of concern in the education arena, instructor qualifications and amount of education (17:38). The first of these concerns, instructor qualifications, has been addressed specifically with the hiring of four professional instructors. Three of the four have had specific implementation experience, and all four are American Production and Inventory Control Society (APICS) certified. Since the instructors are resident at the ALC and are government employees, they feel that they can assimilate the specifics of the OOALC production processes without difficulty. This impression was shared by members of the implementation team.

The instructors saw themselves as salesmen as well as teachers, responsible to "get the word out" about MRP II and generate enthusiasm. They see their greatest challenge as convincing their students to trust the formal system.

The current plan of in-house instruction represents a significant commitment by OOALC to extensive education. By total OOALC implementation the goal is 100% education, meaning everyone working at the center. Their course are divided into ten modules as part of their "University of Maintenance." The overview is one of these ten modules. The modules use a prerequisite sequencing of courses and can be tailored to match the needs of the particular student. The other modules are bills of material, capacity planning,

inventory, master scheduling, master planning, routing, shop floor control, tooling, and cost management.

The methodology of instruction for the modules uses lectures, application questions, video tapes, exercises, open discussions, and a final test. The instructors felt the test was a very important aspect of the process, ensuring not only motivation but feedback for both the students and the instructors.

In terms of resources, the education branch seemed satisfied with the support provided to their aspect of the overall implementation effort. The branch has several newly refurbished classrooms and is eagerly awaiting the arrival of Z-248 personal computers for a computer classroom. This classroom will facilitate student improvement of their computer literacy and also allow application of the principles learned in the classroom with the aid of interactive MRP labs.

Beyond the contractor supplied and in-house education planned, MRP courses are available at a local Ogden university, Weber State. The government will cover one-half to two-thirds of the cost for these courses, but enrollment still requires money, time, and effort from the student. Many of the OOALC personnel were availing themselves of this opportunity in spite of the costs associated.

While none of those interviewed had a specific count, independent estimates put the total participation in the hundreds of people. More than any other single point, this displayed the dedication, commitment, and spirit of the organizations involved in this implementation effort.

A similar college-ALC cooperative was strongly encouraged by the instructors for the other ALCs implementing MRP II. The Weber State-OOALC arrangement was a result of the current Deputy Program Manager's (DPM) contact with the university and the local APICS chapter. He wanted to develop and offer a curriculum to complement the MRP II implementation effort. One of the instructors, who worked for Weber State and was instrumental in the development of the class offerings, said that there is a one year lead time between commitment to an MRP cooperative program and its completion. Therefore, subsequent implementors need to start early to ensure a program is available for their employees.

Training is still in the future, the immediate emphasis is on education. As implementation gets closer, two of the four instructors will switch from education to training. The bulk of the initial education should be complete by then, allowing the educators to administer the recurring and accession instruction, while the trainers can concentrate on training requirements.

The interviews with the instructors left the researcher with a very favorable impression of their capabilities and experience. Their dedication and commitment seemed quite genuine. The recruiting and hiring of these professional instructors may well prove critical to the success of MRP II implementation at OOALC.

Project Implementation Team. Four separate implementation teams involved with the MRP II project at OOALC were investigated, three at Ogden and the command team, HQ AFLC/MA-4, at Wright-Patterson AFB. The researcher extensively interviewed within each of these offices. The results will start with the ALC teams and conclude with the AFLC team.

There is an OOALC team assigned to each division (MAN-1, MAB-1, MAK-1, etc.) and an overall team for the ALC, MA-1. Each of these offices is manned by insiders, people from within the organization. A broad field of expertise is represented with member experience including scheduling, production, planning/engineering, material, and quality. When asked if any specialties are missing, the replies included DS (supply), systems, and finance. There is a DS representative in MA-1, but one of the teams felt a "local" representative would be more helpful.

There are currently nine people assigned to MA-1, four to MAN-1, and five to MAB-1. Turnover on the teams has

reduced considerably as implementation draws closer. In fact, respondents told the researcher they were frozen until implementation is complete. While this stability is desirable from the standpoint of the project, some team members were concerned about the personal effect this would have on their careers. There seemed to be very limited mobility within the implementation offices in terms of both position and grade. Some team members felt demotivated by this situation.

In terms of accountability, there was a feeling of "responsibility without rights," expressed by several team members. They felt that they had little to no authority but enormous responsibility for the success of the implementation. In one case a team member characterized the implementation teams as the "fall guys" if implementation is unsuccessful. The same individual was asked if he thought the teams would get credit if implementation was successful. He responded: "I doubt it."

This apparent lack of clear identity was further reinforced with the responses to the follow-up question: "to whom does this office report?" The responses were varied, often accompanied by smiles and laughter. Several respondents said "that's a good question, I don't really know!" On other occasions the respondent queried a fellow office worker for their impression. The researcher found

this surprising in a military organization. In this case it seems that the channels of authority are diffuse and overlapping. MA-1 is assigned to the OOALC/MA and the other offices report to their divisions. However, this reporting chain seems to be interrupted by perceived responsibility to MA-1 in the case of the division offices, and MA-4 in the case of MA-1.

As far as their relationship with MA-4 is concerned, the field team members were less than enthusiastic about their headquarters counterparts. A specific quote echoes the general feeling among team members:

> ... we'll probably do OK in spite of their help. If they would just leave us alone we could get the job done faster. You see, they don't seem to have a clue about what goes on out here. We don't have a clue about what goes on there either, I suppose, but then again they aren't putting in MRP, are they.

The apparent friction between the field and the headquarters seems to be aggravated by the physical separation and different priorities of the two organizations.

In terms of education and experience, the OOALC team members have all received the GDS overview education and most were or are enrolled in Weber State courses. However, the only experience any of the project office members had was through their implementation team affiliation, none had any prior experience with an MRP implementation. This was

not seen as a problem by the team members, as GDS is to supply the MRP II expertise while they provide the operational skills. Each team member had been working at the ALC from four to more than twenty years before assignment to the implementation teams.

The headquarter's team, MA-4, presented many similarities and differences to their field team counterparts. The mission of MA-4 is to act as the command's project office, including liaison between the contractor and the field units. This office is the focal point for all AFLC MRP II activities. The make-up of the fourteen member team is similar to the field teams, with some experienced ALC representatives assigned. However, several of the positions are manned by personnel with no ALC experience. This shortcoming is compounded by the lack of MRP II education. One team member had received no MRP II education (although scheduled to receive an overview) yet had been working in the project office for several months. It seemed to the researcher as well as to the individual involved that education should have been the first task after arrival. Only after education can team members fully contribute their field expertise to their duties.

The MA-4 respondents conveyed the same uncertainty expressed by the field offices about their authority and responsibility. While feeling responsible for the overall

success of the implementation within AFLC, they felt they have very little control over the project. Authority was felt to rest in AFLC Headquarters or at the ALCs.

Change Management. The magnitude of the change in operations dictated by MRP II implementation was recognized and voiced by each of the interview respondents. In this context, change management includes planning, preparing personnel, and dealing with conflicts arising from the change.

Planning. Transition to MRP II implementation is following an incremental plan. The system will be exercised and evaluated starting with a conference room pilot of the C-5 landing gear in MAN by the fall of 1989. The conference room pilot will act as a table top operational test and evaluation (OT&E). The execution of the conference room pilot will take place in MA-4 at Wright-Patterson, but will use data from OOALC and involve MAN personnel in its execution. Five MAN personnel will work in Dayton while the rest of those involved will operate from Ogden. The conference room pilot is designed to validate the system design and uncover problem areas in its execution. Several benefits of this approach were identified in the interviews. First, it will allow the project teams and the contractor to "iron out some of the bugs before it (MRP II) gets to the shop floor." Also, the conference room pilot is less

expensive than its actual counterpart in terms of dollars and risk. The risks include interruption of operations and impact on morale and enthusiasm should the system design prove flawed. Additional benefits include user involvement, accelerated exposure to the system, and reduced OT&E time.

The conference room pilot will be followed by full OT&E in MAN, using the C-5 landing gear, the hydraulics shop, and F-16 composites. These areas are scheduled to come on line in parallel to the present system. It is hoped this design will avoid interruptions in production should unexpected problems with the system surface.

Once the OT&E is complete, MAN should be ready for cutover to MRP. During this period of transition it is hoped that MAB and MAK will be underway with their pilot sections, which are as yet unspecified. Once OOALC is complete with change-over to MRP II, the project focus can move to the other ALCs scheduled for implementation.

Preparing Personnel. As noted in Chapter II, the most important ingredient for successful implementation is the people. Preparing them for the change was felt by respondents to be not only beneficial but a necessary prerequisite if MRP II "is to have any chance of success" at OOALC. The major avenue of preparation is education, discussed previously in this chapter. It is hoped that the education process will eliminate most of the personnel

problems associated with implementation, allowing them to understand the reasons for the changes and realize "the impact they will have on MRP and the impact it will have on them."

Beyond the education of employees, there is an active advertising campaign for the project. This campaign is in the form of posters and bulletin boards throughout the facilities. The members of the implementation teams see themselves as salesmen and cheerleaders for their project. Several members of the implementation teams have designed the posters. These advertisements both praise the benefits of MRP II and announce the hard work and commitment required for successful implementation.

Conflicts. Resistance to the changes required by MRP II implementation was a particularly interesting topic among the interview subjects. Of note were several specific incidents related by the respondents. One involved a first line supervisor skeptical of project success who told an implementation team member: "you better know where the off button is" for the MRP II system. The researcher found that this attitude, while not the majority view, was not uncommon among the more senior employees. This, the interviewees felt, is a result of the experience these individuals have had with other AFLC major projects. Projects such as the Advanced Logistics System (ALS) and the Maintenance Job

Tracking System were introduced and pushed in ways similar to MRP II. As an anonymous respondent stated,

> (These systems) promised great things, but in the end were abandoned as it became obvious they just wouldn't work. Unfortunately, management held on to the projects long after the workers saw that they just wouldn't work, that's what really soured the older guys on big projects.

While many of the respondents had a specific incident of resistance to relate, their overall estimate of conflict during the transition was low. They forecast compliance as a result of education, managerial example, and peer pressure. But there have been instances where management has taken action when resistance to change has interfered with the progress of the project. Interview respondents in each of the organizations studied related incidents about removal or transfer of individuals unable or unwilling to adapt to the required or planned changes brought about by MRP II implementation. This certainly shows management resolve to confront resistance early and decisively.

Expectations of Success. While discussing the management of change, the interviewees were also asked about their expectations of implementation success, how likely MRP II was to succeed, as well as the impact of project success or failure in MAN on the implementation throughout AFLC. There were a variety of answers, somewhat divided along organizational lines. The respondents at OOALC were

unanimous in their belief that it would succeed. They felt, as one second line supervisor stated: "...this is too good a system not to work. We'll make it work, it may take some time, but it'll get done." Respondents not in MAB felt that MAN's probability of success was very high, since their process more closely resembles the classic manufacturing environment for which MRP II was designed. MAB respondents agreed that MAN would succeed in implementation, however many felt that MAB would do as well or better. This enthusiasm seemed to stem from very strong top level management support within the division, and a belief that their already existing data base would give them an advantage in implementation.

The researcher followed-up this question to define the meaning of 'success' as used by the respondents. They were mixed, ranging from high Class C to B in their descriptions (see Appendix D). This does not meet the researcher's stated criterion for success, which is Class A. When asked why they felt Class A was not reachable, the responses uniformly pointed to the non deterministic process of the remanufacturing environment. They felt that since they could not determine dependent demand with 100% accuracy that the system would necessarily fall short of the success attainable by strict manufacturing organizations. This view was not shared by the instructors, who alone felt that the

only limitation on the level of success MRP II could enjoy was management commitment. This struck the researcher as an interesting disagreement, one needing specific attention.

Strangely, only two of the respondents pointed to the isolation of MA in implementing MRP II. Both DS (supply) and MM (material management) are integral to the operation of the ALC, and neither are a planned part of the MRP II process. Since MM acts as the manager for requirements and DS the vendor for the center, it seems that their participation is necessary for significant success in MA.

Respondents at the headquarters did not share the enthusiasm for success noted at OOALC. While not thinking it would fail completely, several were skeptical about the level of success MRP II would achieve. They put success for MAN in the Class D to low C range, and were hesitant to predict the level of success for MAB or other ALCs. This variance in expectations seems to be a potential problem for the implementation. While not violating the principles of need, commitment, and plan stated in Chapter II, there does not seem to be a commonality of goals between or within the implementing organizations.

Knowing their feelings about the probability for success, the respondents were then queried about the impact of success or failure in the MAN implementation on the future of MRP II in AFLC. One respondent spoke for many:

> If (MRP) succeeds, we'll become the showplace for MRP II in the repair environment, if we fail, they (AFLC) won't be able to bring in another big system like this for a long time. It will kill MRP II in the command.

There seemed to be agreement that the MAN implementation will conclusively determine the future for the project within AFLC.

Data Accuracy. The literature in Chapter II identified inventory and BOM accuracy as critical to MRP II success, since they represent two of the three primary inputs to the MRP software. The present BOM accuracy within MAN was estimated between 90 and 95 percent. While still below the recommended 98 to 99 percent, the stochastic nature of the environment seems to be a limiting factor, as discussed in last year's study (17:54). The divisions are placing a great deal of emphasis on building the BOMs, dedicating growing numbers of personnel to the effort. In MAB alone the size of the BOM section within MAB-1 will soon double from five to ten.

The inventory situation is much more dynamic this year than last. A major project currently ongoing is the transfer of the shop floor inventory centers, or MICs (maintenance inventory centers), from MA control to DS control. This is a separate effort from the MRP II implementation and does not represent inclusion of DS into the planning portion of MRP II operation. One respondent

did note that the closer proximity of DS to MA's MRP II operation will "give them (DS) an insight they never had before, allowing and encouraging them to mesh with the new system (MRP II)."

As reported last year, cycle counting and ABC classifications will provide inventory control (17:57). According to a DS representative on the implementation team, the DS controlled MICs will also use what is being called floor stock. Floor stock will allow tight control and accounting for parts that were previously loosely controlled, particularly C level items such as nuts and bolts, fasteners, etc. Floor stock will be in the form of easy access bins, open to the workers, that have been accounted for and charged to MA. The bins will be filled from the MIC as needed, but MA will not be charged for the parts until they are transferred to floor stock. Likewise, MA will not have access to the parts until transferred, assuring DS the accountability necessary to their operations.

Pilot Program. There are three pilot sections for the MRP II implementation in MAN, discussed earlier in this chapter. The pilots, or OT&E, are designed to test the system prior to full scale implementation. The three MAN sections, C-5 landing gear, F-16 composites, and the hydraulics shop, were selected because they represent a

cross section of the organization's processes while still somewhat independent of the other operations. It is felt that bringing these three sections on line with MRP first will allow testing of the system's concepts in different environments. The other sections can then benefit from the lessons learned during the pilot portion, saving the expense, risk, and confusion that might accompany a cold turkey organization wide implementation (38:153-154). The conference room pilot, discussed earlier in this chapter, will fulfill many of the tasks of the pilot approach. It will allow the users to become more familiar with using MRP while exposing any potential weaknesses in the design.

Questionnaire Results

The section on questionnaire results has two parts, the first relating directly to interview results and the second pertaining only to analysis of the questionnaire results. The specifics of the questionnaire mechanics and analysis appear first, followed by the two analysis sections. The data used in analysis are extracted from computer output found in the appendices and identified within the text.

Questionnaire Analysis

The questionnaire analysis will consist of three parts. First, the response data, followed by categorization of questions and finally analysis of results.

Response Data. There were 224 questionnaires distributed to the organizations under study. One hundred each were sent to MAN and MAB, with the remainder going to MA-4 and HQ AFLC. Of those distributed, 145 were returned. Many of those returned were incomplete or mismarked. Modification of the SPSS-X program accounted for incorrect or missing data by considering them blanks and not including the numbers in computations.

The return breakdown by organization follows:

Table 1

Questionnaire Responses by Organization

Number	Organization	Percent
56	MAN	38.62
64	MAB	44.14
11	OOALC	7.59
8	MA-4	5.52
5	HQ AFLC	3.45
1	Other AFLC	0.69

MAN and MAB account for 89.66% of the total response, with non-OOALC responses totaling only 9.66%.

The distribution by duty position is shown in Table 2. Note that Users compose the largest portion of respondents, consistent with the goal of the questionnaire to reach down to the lower levels of the organization for data.

Table 2

Questionnaire Responses by Duty Position

Number	Duty Position	Percent
25	Manager	17.24
51	User	35.17
35	Systems	24.14
34	Other	23.45

Question Categorization. As described in the methodology, the questions were grouped by logical association into four categories: Management Support, Understanding of MRP, Impact of Implementation on the Organization, and Likelihood of Successful Implementation. While retaining these four categories, the questions were further analyzed using the Chi-Square computation provided with the Crosstabs command in SPSS-X. Significance levels of less than 0.05 were used for grouping questions based on the key question for a particular category. This was done using programs 28 through 32 found in Appendix F. Any question falling inside this threshold, when cross-tabulated with a key question, was further analyzed for logical association. Questions passing both tests were placed into the category. In several instances a question passed both tests for more than one category and were included in both. Likewise, a few passed neither or failed to pass because

they had little logical value to the research. In either case the question was not assigned to a category. The number of questions per category varied from a low of 10 for Management Support to a high of 39 for Likelihood of Success. The grouping of questions by category is shown in Appendix G.

Since the questionnaire results were consistent with the findings of the interviews (shown in the next section), the categories seem to have validity and therefore value in analyzing the responses.

Interview Support. The interviews were divided into six sections, of which four have either partial or direct overlap with the questionnaire categories. The applicable sections are: Management Support, Education, Project Implementation Team, and Change Management.

Management Support. This category corresponds directly with the interviews. The questionnaire has ten questions in the management support category, with question 6 the key question for the grouping. Examining the overall response to the key question regarding agreement with the statement "Top management supports MRP," the results show agreement. The mean response was 2.7, with the mode response of 2 occurring at four times the frequency of responses 5 or 6 (Appendix H). This corresponds with the positive interview results about management support.

The interviews also showed that headquarters respondents felt greater frustration about management support than their OOALC counterparts. Comparing the categorical responses, controlling for organization (Appendix I), seems to support this finding. The mean response for MAN was 3.0, 3.2 for MAB, and 3.3 for the headquarters. The ANOVA/Tukey results (Appendix J) confirm a difference between MAN and MA-4, with MAN showing the more positive response to management support. The MAN and MA-4 groups were the only ones showing significantly different responses in this category.

When analyzed by position, no statistically significant differences surfaced (Appendix K). Again, this finding is consistent with the interviews, which noted no apparent difference in attitude by duty position.

Education. The Understanding category of the questionnaire complements the Education section of the interviews, since the employees' understanding of MRP is a result of the educational programs presented to them. The questionnaire responses add information to the interviews through categorical analysis as well as investigation of groupings differentiated by duty position. The interviews showed responses to the Education section of the instrument to be more homogeneous than that found in Management Support. This assertion is supported by the questionnaire results. The ANOVA/Tukey results, when controlled for

organizations (Appendix J) and positions (Appendix K), shows no statistical differences between groupings at the 0.05 level of significance.

The 3.07 mean response indicates moderate agreement with the Understanding category by the entire sample (Appendix J). There was no statistical difference between the three primary organizations, MAN, MAB, and MA-4. MAN expressed the highest degree of understanding (3.02), followed by MA-4 (3.13), and MAB (3.14) (Appendix J). (Note: The means for categories are computed by dividing the reported mean for the category by the number of questions in the category.)

Similar agreement is found when controlling for duty position, with values ranging from a low of 2.91 for systems personnel to a high of 3.19 for 'Other'.

A specific area of concern noted in the interviews was management's understanding of the system. The questionnaire results indicate that management feels moderate agreement with the Understanding category, posting a mean score of 3.05 (Appendix K). This indicates that management feels they understand MRP.

Examination of question 40 allows the research to differentiate the sentiment concerning management understanding. The question asks for agreement/disagreement with the statement "Management does not understand the requirements of my MRP duties." The user's mean response is

3.25, indicating slight agreement with the question's assertion (Appendix M). The systems personnel have a mean response of 3.12 (Appendix M).

The results of Question 40 indicate that there is some doubt among non-managers about management's MRP understanding, while management themselves feel they do understand. (Management is almost neutral in response to question 40, but the question is directing the focus of the response to the individual's manager rather than examining their own understanding of their subordinate's duties.)

Question 46 examined specifically the awareness of respondents to the educational programs offered by their organizations. The responses indicated agreement with the statement "There is a continuous educational program to educate users with respect to the MRP system and changes made to it." The overall mean response was 3.18, with management the most positive (2.83) and users the least (3.31) (Appendix N).

Organizational analysis of Question 46 shows MAN with the strongest agreement (3.06), followed by an almost neutral MAB (3.39), and MA-4 just slightly on the disagree side of the scale (3.57) (Appendix L). There are obviously differences in how the organizations view their management's understanding of MRP. Again, each group is addressing a separate 'management.' In this case, MAN and MAB are

commenting on their division leadership, while MA-4/HQ AFLC responses are focused on headquarters level management.

Project Implementation Team. While no particular questionnaire category overlaps specifically with this interview section, there are several individual questions pertaining directly to the Project Implementation Team. For the most part, the term 'design team' is used interchangeably with 'implementation team' in the questionnaire and during its analysis. MA-4 is the only organization where interchangeable labeling will not apply, as to them the design team is strictly the contractor (GDS) separate from the implementation teams located at the ALC.

Questions 26 and 27 examine Project Implementation Team manning. While neutral (mean=3.51) about the turnover rate being low (Appendix N), there seemed to be disagreement with question 27's assertion of too many people on the team. The mean response for question 27 was a slightly disagreeing 3.93 (Appendix N). But the significant finding came from the Tukey analysis of the question when controlling for duty position (Appendix N). A statistically significant difference, at the 0.05 level, was shown for users and systems personnel (Appendix N). This difference probably stems from the high Project Implementation Team representation in the systems personnel sample, influencing their mean response (4.45) toward disagreement.

Question 28 asked for agreement concerning team knowledge of organizational operations, in other words, does the Project Implementation Team have the background necessary to act as the link between the system designers (GDS) and the users. The mean response was 3.45 (Appendix N) with the Tukey analysis showing no differences by position. This seemed high in light of the interview findings that all of the offices are manned by "natives" of the particular organization.

When analyzed by organization, MA-4 showed the strongest agreement with a mean answer of 2.18, indicating high confidence in the operations knowledge of the teams (Appendix O). There is a difference between MA-4 and MAB (mean=3.78), according to the Tukey analysis (Appendix O). It seems that MA-4, with some non-ALC experienced personnel, sees themselves and GDS (jointly the headquarter's implementation/design team) as having high user knowledge of the organization's operations while MAB, whose design team (MAB-1) is composed entirely of insiders, has slight disagreement with the team's operations knowledge.

The organizational results for question 28 seem almost paradoxical when contrasted with question 35. Question 35 states "The MRP system designers understand the users' information needs." The overall mean for this question is a neutral 3.49, but the three organizations show interesting

differences (Appendix N). MAN was the most positive (Mean=3.27), followed by a nearly neutral MAB (3.52), and a disagreeing MA-4 (4.0) (Appendix O). It seems strange that the organization most positive about the design team's operational knowledge would also be the most negative about the same team's understanding of the users' information needs.

Change Management. The change management portion of the interviews overlaps with the two remaining questionnaire categories, Impact of Implementation and Likelihood of Success. The questions in the Impact category relate to the personal and organizational changes confronted by personnel as a result of MRP implementation. The Success category seeks impressions and opinions about the probability of successful implementation within the organization.

The interviews already showed management resolve in dealing with chronic change resistors, as evidenced by the reassignment of supervisors in response to several situations of non-cooperation. This resolve is reflected in the mean response of 2.63 (Appendix N) by managers to the statement "The MRP system has produced stress between certain areas of the organization" found at question 17 in the questionnaire. The question reflects the difficulty experienced by personnel as a result of implementation. The

average response for the entire questionnaire sample was 3.08, showing moderate agreement (Appendix N). The managers did show the strongest agreement, perhaps reflecting the pressure they feel to make the system work. The users and systems personnel were almost equal at 3.04 and 3.06 respectively (Appendix N).

By contrast, the overall response to the impact category shows management (2.96) and users (2.94) almost equal in their agreement, with the systems personnel only slightly higher at 3.06 (Appendix N).

When differentiated by organization, the mean responses are distributed about the overall mean of 3.03, with MAN the most positive (2.94) followed by MAB (3.04) and MA-4 (3.37) (Appendix J). Tukey analysis shows a difference in attitude between MAN and MA-4, with MAN seemingly and understandably feeling greater impact, presumably because they (MAN) are further along the path to implementation.

The Success category is keyed on question 10: "MPP will work in our organization." This question evoked relatively strong agreement among respondents with an overall mean response of 2.56 (Appendix N). The interviews found division along organizational lines concerning the degree of success or possibly the enthusiasm for success. The questionnaire results did not bear this out. No statistically significant differences were noted between the

organizations (Appendix J). In fact, while MAB impressed the researcher as being the most enthusiastic about their program, their mean response was less positive than MAN (3.01 vs 2.92) (Appendix J). MA-4 was the least positive of the three with a mean response of 3.18 (Appendix J).

When examined while controlling for duty position, the results proved fairly homogeneous. The overall mean for the Success category was 2.98, with systems the most positive (2.91) followed closely by managers (2.93) and users (2.97) (Appendix K).

The questionnaire substantiated those interview topics where the two instruments overlapped. The only incidence of conflict between the two arose in the Success category, and that difference was neither profound nor contradictory. The conflict involved the apparent enthusiasm MAB has for the implementation contrasted with a Success score less positive than in MAN. Otherwise, each contention was either reenforced or unaffected by the interviews.

Analysis of Questionnaire Results. Much of the data analysis for the questionnaire was presented in the previous section supporting the interview findings. This section will cover areas not identified previously and provide a summary of findings.

In Chapter III the research forecast differences in attitudes based on the respondents' organization or duty

position. This proved to be the case, and this section will examine those differences.

MAN and MAB receive the preponderance of attention in this section of the analysis due to their overwhelming contribution to the sample. MAN and MAB together account for almost 83% of the questionnaire responses. MA-4, the other major organizational subdivision, constitutes only 5.5% and was consequently not given the same weight in the questionnaire analysis as it was for the interviews.

The Organizational and Positional subsections of the questionnaire analysis are further divided into categorical and individual portions. The Categorical portion examines differences occurring between the four categorical subgroups used in the interview support section. The Individual portion refers to differences found in responses to specific questions.

Organizational.

Categorical. Two categories had statistically different responses when controlling for organization. Management Support showed a difference between MAN and Other OOALC, which is composed primarily of OOALC/MA-1 personnel. While MAN shows a positive mean of 3.04, MA-1 is a neutral 3.53 (Appendix J). Again, the management serving as the focus for this question is different for each group. The details of those differences

were discussed in the interview portion of this chapter. MA-1 showed a more diffuse identity in terms of a chain of command than was experienced in MAN. Consequently, the support received from top management may seem more diffuse, evoking the neutral response.

The Impact of Implementation category produced another difference, in this instance between MAN and MA-4. MAN again is more positive at 2.94 while MA-4 is a more neutral 3.37 (Appendix J). Considering the dramatic change in working methods required at MAN due to implementation, the results are understandable. MA-4 is a staff agency acting as the HQ AFLC project office for the implementation, duties differing little from those in other staff or project offices. Therefore, the impact of implementation would be expected to be less.

Individual. MAN and MAB differed on five questionnaire responses, according to the Tukey analysis at a 0.05 level of significance. These five questions were numbers 5, 6, 17, 39, and 63 (Appendix O).

Question 5 states "MRP requires unlearning old work methods and acquiring new work methods." This question was not assigned to any of the four categories (Management Support, Impact of Implementation, etc.) because it did not pass the Chi-Square portion of the category criteria. However, the researcher considers the question logically

reflects recognition of the changes required for implementation. Both MAN and MAB had mean responses in agreement with the statement (1.68 and 2.33 respectively), with the differences stemming from the magnitude of agreement (Appendix O). The disparity may reflect the differing stages of implementation in the two organizations. MAN is further along the path to implementation and respondents are more likely to have experienced changes in their work methods as a result.

The next response difference was found at question 6. This is a particularly interesting question, since it is the key question for the Management Support category. As a key question, there should be little chance of ambiguity in the meaning of the responses. MAN's mean response to the statement "Top management supports MRP" was 2.16, showing strong agreement. MAB also agrees with the statement but with considerably less magnitude. MAB's mean response of 3.18 shows only slight agreement, indicating that support by top management is at least more visible in MAN than MAB. Again the difference probably arise om the more advanced state of implementation at MAN. Management involvement at MAB seems to e strong at high levels, indicated by the very positive responses in the interview section of the research.

The results and analysis of Question 17 parallel those presented for questions 5 and 6. The statement "The MRP

system has produced stress between certain areas of the organization" elicited responses in keeping with the levels of implementation in each organization. MAN has evidently and logically experienced more stress resulting from implementation than has MAB. The mean responses reflect this disparity, with MAN's at 2.59 while MAB's is a near neutral 3.44 (Appendix O).

Question 39 measures agreement with "I understand other MRP users' duties." Since the levels of education are greater at MAN then MAB, a difference in responses is not surprising. However, this is the first instance of the two organizations falling on opposite sides of the agreement continuum. MAN was in moderate agreement with the statement with a mean response of 3.29 (Appendix O). MAN's mean response falls on the disagree side at 4.06 (Appendix O). The difference in attitudes can probably be linked to the levels of familiarity with the MRP system possessed by each organization. As MAB gets closer to implementation this attitude should be expected to change.

The results of question 63, "MRP is a significant change from the previous manufacturing control system," is another example of MAB's shift to the right of MAN. MAN had the lower mean response (1.88 vs. MAB's 2.65), just as in the previous four questions. This statement is very similar to Question 5, but Question 63 qualified for three of the four

categories while 5 qualified for none. The three categories are: Understanding of MRP, Likelihood of Success, and Impact of Implementation. The results are very close to those found in Question 5, presumably for the same reasons previously identified, i.e. the levels of advancement in implementation.

Positional

Categorical. The four positions identified on the questionnaire, Management Support, User, System, and Other, presented only one statistically different category. The difference was found in the Impact of Implementation category and exists between Users and Other (Appendix K). Since it is impossible to determine the duties of respondents in the other category, little information can be drawn from this discovery. The mean response for Users was the most positive at 2.94 while Other was the least positive at 3.16 (Appendix K).

Individual. Thirteen separate questions show statistically significant differences between positions. Those with differences are numbers 9, 10, 11, 20, 21, 27, 33, 47, 56, 61, 63, 70, and 71 (Appendix N). Questions with differences only between Other and another position are not discussed because of the limitations previously delineated in the Categorical portion of the analysis.

System personnel appear far more positive about the utility of the MRP system than are the Users when comparing MRP to the previous methods of control. This is indicated by the responses to Question 9, where Users had a mean response of 2.8 while Systems personnel responded at a very positive 1.9 (Appendix N). This seems logical, since the intricacies of the old system were very well understood by the Users, while the new system is more mysterious. The Systems personnel are not only familiar with but also responsible for the changes in operating systems and equipment. Without a working MRP system, Users are understandably less enthusiastic about MRP's utility.

Question 10 is the key question for the Likelihood of Success category, asking for the degree of agreement with "MRP will work in our organization." Again, Users and System personnel differed in the magnitude of their agreement. Systems showed strong agreement (mean=1.97) while Users were not as positive (mean=2.92) (Appendix N). The source of the difference in responses may be the amount of education and exposure to MRP. Systems personnel receive the first and the most education. Additionally, the perception of MRP system ownership would logically be strongest among those responsible for its design and implementation.

The next question with statistical significance is number 11. The statement "MRP requires new personal relationships that are uncomfortable for me" again separates the Users from the Systems personnel. Both groups disagree with the statement, but the Users (4.52) disagree with less strength than the Systems personnel (5.24) (Appendix N). The central argument for explaining this disparity is the difference in exposure and commitment to the implementation by each group.

Questions 20 and 21 are closely related, dealing with perceptions of Data Processing personnel. Question 20 asserts that Data Processing personnel hold a higher position in the organization than Users, while Question 21 states that Data Processing personnel lack a technical understanding of the work process. Data Processing personnel fit into the Systems category and, as might be expected, the differences in responses to these questions involve the systems group. In question 20, the difference is with the Users, who act as the basis for comparison for data processing status. While Users are almost neutral in response (mean=3.42), the Systems response is decidedly negative (4.30) (Appendix N). Systems do not consider Data Processing personnel (a segment of the category) more highly placed than Users. The Users are somewhat mixed in their opinion, showing neither agreement nor disagreement.

Question 21 finds Management differing with Systems. While the System respondents reply very slightly on the negative side (mean=3.77), Management is fairly positive (2.73) (Appendix N). Management feels data processing lacks process knowledge, in conflict with the Systems personnel's perception.

Another instance of specific group targeting resulting in response differences is Question 27. The statement in this question is very straight forward: "Too many people are on the MRP design team." The design team falls into the Systems category, a group disagreeing with the statement (mean=4.45) (Appendix N). The Users agree slightly (3.48), but enough of a difference exists to evoke statistical significance. The researcher feels safe in assuming parochial interest is reflected in the responses by each group.

Question 33 shows significant differences between Users and Systems in response to "The MRP system users make decisions based on the reported information." Since the responses from both groups are very positive (2.88 and 2.27) and considering there is no actual working system, no conclusions are drawn from this difference.

Questions 47, 56, and 61 are similar, each addressing the respondent's contribution to the MRP system design. All of the questions find System personnel responding the most

positively, understandable since MRP system design is most directly their responsibility. In fact, Question 47 finds not only difference but disagreement between Systems and both Management and the Users. Question 56 shows difference and disagreement between the Users and Systems personnel only. It seems that Users feel distant from the design process and that their impact on system design was not significant.

Question 61 is phrased in a negative manner, and the responses are consistent with those in questions 47 and 56. The statement "Design of the MRP system required little of my time or effort" met with agreement (mean=2.77) by the Users and disagreement by the Systems personnel (4.03) (Appendix N).

The significance of change resulting from MRP implementation is the topic of Question 63. User and System responses were again the ones found statistically different. Both responses were very positive, 2.51 for Users and 1.76 for Systems, similar to the responses to Question 33 (Appendix N). It is likely that the magnitude disparity reflects each group's awareness levels of the changes required for implementation.

The last two questions both measure attitudes about the timeliness of MRP system outputs. In Question 70, only Users and Systems were different, but both fell on the

disagree side of the scale (Appendix N). Responses to question 71 by both Management and Users differed from Systems. Systems personnel felt the greatest disagreement with the contention that it is difficult to report transactions on a timely enough basis to provide control. The mean response for Systems was 4.42, while Management and Users had mean responses of 3.30 and 3.58 respectively (Appendix N). System personnel confidence in MRP's ability to function properly and appropriately conflicts with the other position's neutrality or doubt.

Summary

This chapter has analyzed the primary data collected by the interview and questionnaire instruments of the research. The analysis was divided into three separate sections, interviews, questionnaire support of the interviews, and questionnaire responses alone. The results found several areas of conflict between organizations and duty positions while simultaneously confirming logical similarities. The results presented in this chapter are applied to the investigative and research questions in Chapter V.

V. Conclusions and Recommendations

Overview

Chapter V applies the information presented in Chapters II and IV to the investigative and research questions of the thesis. The conclusions reached in answering the questions are followed by recommendations for improvement. The chapter closes with recommendations for future research.

Conclusions

Historical View of the Project. This research of the MRP II implementation project in AFLC shows a great deal of progress since the previous study. Much of the current status is presented in various forms throughout Chapter IV. This section will summarize some of the key issues.

The MAN division at OOALC is ready to begin the first phase of OT&E, the conference room pilot. The conference room pilot is scheduled to begin in the late summer to fall of 1989. A shop floor pilot in the C-5 landing gear, F-16 composites, and hydraulics sections will follow, with the schedule dependent on the results of the conference room pilot.

There is a great deal of enthusiasm for the project within MAB, where implementation efforts are much more

visible this year. Like MAN, MAB seems to have top management support for the implementation effort.

Other priorities are competing successfully with implementation efforts for the number two priority in the organization. QP-4 is the major culprit, but temporal "hot" projects also affect project status.

The OOALC MRP Education and Training section is in place and ready to commence activities. Four professional MRP instructors were hired to teach the classes to personnel on site. Support for education and training is evident in the resources devoted to the task. Resources include not only the instructors, but classroom space and instructional equipment as well, including personal computers.

Turnover on the implementation teams has virtually stopped. The teams are fully manned with personnel from a variety of specialties. While performing a staff function, the teams do feel responsible for the success of the project, although no particular accountability has been specified.

There is a good deal of friction between the ALC implementation teams (MAN-1 and MAB-1) and the Headquarters team (MA-4). Some of the resentment comes from differing perspectives of the two levels and their unique roles in the implementation effort. However, abrasion seemed to be compounded by the physical separation of the organizations.

Resistance to change is still existent at OOALC, however it seems to be receding as MRP education permeates the organizations. Management has moved more than one individual to other positions when criticism of the MRP II implementation process became too belligerent.

Employees feel positively about the eventual success of the project. Again, as education progresses, more people are recognizing the benefits of MRP II.

MA is still isolated from the other two components at OOALC (MM and DS) in their effort to implement MRP II. While DS work areas will be interfacing with MA workers on the shop floor after MIC responsibility transfer, there is still no plan to integrate DS fully into the MRP system.

The preceding summary of OOALC status is designed to act as a snapshot of major activities, facilitating comparison of this study with future works. The following sections will answer the remaining investigative questions.

Status of Identified Problem Areas. Several areas were identified as problems during the previous study. This section will examine previously identified problem and discuss the changes or progress made during the last year.

A lack of pre-implementation education was seen as a potential problem in the previous study (17:71). There are still some reasons for concern, since initial education is

not complete at OOALC. However, the stated goal is still 100% education before implementation. The newly staffed on-site education/training section at OOALC feels confident in its ability to complete any non-contract education requirements prior to implementation. A bright spot in terms of education is the voluntary enrollment of a substantial number of employees in off-base MRP classes at Weber State. The researcher feels pre-implementation education will be sufficiently complete enough to avoid being a limiter for implementation success.

Training is seen as a potential problem by this study. For the most part, training activities are still on the drawing board, with little to no hands-on activity by the users.

While identified as a problem last year, resistance to change seems to have dissipated substantially at OOALC over the past year. This improvement can be attributed to the increase in education at the center and the visible commitment to the project by management.

The amount of transition time available to organizations implementing after MAN was seen as another questionable area. While MAN will have had approximately 60 months of preparation prior to implementation, subsequent organizations will only have 20 to 30 months (17:73). While one to two years is considered an optimal span, there was

doubt about future implementors being able to meet the schedule (20:196;38:16). While the amount of time available for transition has not changed, this study was able to examine an organization under the tighter constraints. MAB will implement without MAN's "head start." MAB has every confidence in their ability to accomplish implementation within or close to the scheduled date. The scheduled date is hard to predict though, since time tables have tended to fluctuate. The most likely limiter is completion of the BOMs. While the BOM section in MAB feels they can complete the task in a reasonable time, their work to this point has only finished a very small portion of the total, and the total task has not even been fully identified.

The lack of supply activities integration to the MRP II process is a problem that remains from the previous study. There is no clear cut plan for addressing this deficiency. Other than the transfer of MIC responsibility, DS still sees MRP II as a maintenance project neither requiring nor involving them.

At the time of the previous study, pilot sections for MAN were as yet unidentified. The lack of a pilot was validly seen as a problem. Over time project progress has eliminated the problem, providing this research with not only three pilot sections, but two pilot types (conference room and shop floor).

A guarded optimism for success was felt in the previous study. Apprehension seems to be decreasing, with enthusiasm growing for the new system as implementation grows closer.

Many of last year's problems have disappeared or diminished with the passage of time. This was certainly due to the actions of those responsible for successful implementation at all levels of the organization. However, there are still some lingering problems which are significant. The integration of DS into the MRP II system is seen by the research as a major problem which could well jeopardize the system's chances for success. It will be addressed in the next section with other determinants of success.

Likelihood of Success. This section will match the results of the data collection with information in the literature to assess OOALC's chances of successfully implementing MRP II. The literature review identified three prerequisites to successful implementation: need, commitment, and a plan. Since "need" was taken as a given and not included in the scope of this research, the following material will focus only on the "commitment" and "plan" aspects.

Commitment. The strength of the OOALC commitment to this project is shown in three areas, the degree of

management support, the educational programs, and the approach taken to management of change.

Management support seems to be strong at OOALC. The implementation teams are fully staffed, people are aware of the implementation project, and the employees have a positive feeling about management's interest and support.

Education has received substantial attention in the implementation process at OOALC. The four instructors were recruited with great care, requiring a commitment of resources in the form of advanced position grades and wage levels.

Perhaps commitment by management was shown most strongly in their willingness to transfer employees when the workers demonstrated excessive inflexibility. This type of change management shows serious commitment to the project, and word of transfers spreads rapidly, reinforcing the policy.

The three areas examined all show positive commitment to the implementation project. The researcher contends that commitment will not be a limiting factor for successful MRP II implementation.

Plan. Chapter II established the importance of a plan to project success. The effectiveness of planning is reflected in the prioritization, scheduling, and integration of activities.

MRP II should hold the number two priority in an organization during implementation (38:14). As such, the only activities taking precedence should be those necessary for day-to-day operation of the business. Number two priority does not prove to be the position of MRP II implementation at OOALC. Rather, it holds a high position but is subject to preclusion by a variety of other programs and projects. The most notable competitor for priority is QP-4, the quality improvement program. Failing to maintain the number two priority can cause implementation failure even with management support, because the attentions, energies, and resources required are diluted. Additionally, without a high priority the length of time required to implement will grow, further eroding the chances for success.

Schedule. Indications of elongating and vague schedules are already evident. The implementation dates seem very susceptible to advancement.

The actual timing of education and BOM completion are not known at this point, even for MAN. Without a firm plan containing deadlines and milestones, attention is subject to diffusion.

Integration. Combining and complementing the efforts of each organization involved in the implementation can have obvious benefits. However, failure to integrate

pertinent agencies can be very detrimental to implementation. After all, MRP II is designed to mesh together all aspects of the business to reduce waste and improve productivity. This section examines integration in two ways, both within the implementing organization (MA) and between MA and outside organizations.

Within MA, MAN and MAB seem more discrete than homogeneous. Even though their views tend to be the same, each organization feels a unique identity in the implementation process. Much of the separation is a result of the differing processes in each division and the physical separation of the implementation teams. Neither sees the other's implementation plan as analogous to their own.

The lack of integration between MA and either MM or DS is significant to project success. In a crude way, MM activities represent the master production schedule, dictating what will be produced and when. DS maintains the inventory, ordering materials for use by MA. The BOM and routing inputs to the process come from MA. Without all of these inputs MRP cannot work, as they are the foundation of the system. However, half of the inputs fall outside MA's control and consequently are not fully integrated with the system.

The likelihood of successful implementation with the constraints described in this section is low. Without

integration of the two outside agencies into the MRP II plan, the integrity of system information will be virtually impossible to maintain. Once system output is contaminated by bad input, the system will report incorrect information and cause the workers to resort to the informal system. Once the informal system returns, MRP is at best an order launcher.

Conclusion Summary. Although the people involved with implementing MRP II at OOALC are capable, dedicated, and enthusiastic, the project may be facing insurmountable barriers to success. The integration problems appear too large for solution by the implementation teams. Headquarters, command level intervention may be necessary.

Recommendations

This section will present suggestions for improving the chances of implementing success.

To reduce the effect QP-4 has on the attention given to MRP, it would help to have a formal liaison between the two project offices. Dedicating someone to act as an interface between and become knowledgeable of both operations could reduce redundant actions and improve the performance of both.

The lead time for establishing a cooperative education program with a university is approximately one year. To

ensure ALCs implementing MRP in the future have the same opportunities, planning should start now.

Physical separation of offices seems to be a hinderance to effective operations. A joint implementation project office for all of OOALC would provide two benefits: first, it would bring together a larger pool of expertise; and second, consolidation would allow synergistic problem solving and greater continuity of experience.

Physical separation of the Command project office from the implementing locations causes friction between the two. Moving MA-4 to each implementing location, much as a Special Project Office, could only improve the appreciation of each office for the other and improve the resulting product.

Future Research

This research was able to build quite effectively on the results of a previous thesis. This study used established research instruments in an effort to advance the baseline for future study. A follow-on study should examine the relative utility of using personal interviews and a questionnaire. Perhaps telephone interviews and the questionnaire would be sufficient. Inclusion of MAK in a subsequent study would also prove interesting.

Summary

This chapter presented the conclusions of the research. A summary of the state of implementation was presented, followed by examination of problem areas identified in previous research. Next, the likelihood of success was predicted based on the extent OOALC's commitment and plan matched idealized implementations in the literature. Additionally, suggestions are made for the possible improvement of success probability. Finally, recommendations for future research are offered.

The author has serious reservations about the likelihood of success for the MRP II implementation in AFLC. The apparent lack of integration between all aspects of the "business activities" almost certainly dooms the project to failure. It is teamwork, not software, that will make MRP work.

Appendix A: Glossary of Terms

Definitions in this glossary are taken from the American Production and Inventory Control Dictionary (1) and MRP II: Making It Happen (11).

ABC CLASSIFICATION: Classification of the items in an inventory in decreasing order of annual dollar volume or other criteria. This array is then split into three classes, called A, B, and C. Class A contains the items with the highest annual dollar volume and receives the most attention. The medium Class B receives less attention, and Class C, which contains the low-dollar volume items, is controlled routinely. The ABC principle is that effort saved through relaxed controls on low-value items will be applied to reduce inventories of high-value items.

ALLOCATION: In an MRP II system, an allocated item is one for which a picking order has been released to the stockroom but not yet sent out of the stockroom. It is an "uncashed" stockroom request.

AVAILABLE TO PROMISE: The uncommitted portion of a company's inventory or planned production. This figure is frequently calculated from the master production schedule and is maintained as a tool for order promising.

BILL OF MATERIALS: A listing of all the subassemblies, intermediates, parts, and raw materials, etc. that go into a parent item, showing the quantity of each component required. May also be called "formula," "recipe," or "ingredients list" in certain industries.

BUCKETED SYSTEM: An MRP, DRP, or other time-phased system in which all time-phased data are accumulated into time periods or 'buckets.' If the period of accumulation would be one week, then the system would be said to have weekly buckets.

CAPACITY REQUIREMENTS PLANNING (CRP): The process of determining how much labor and/or machine resources are required to accomplish the tasks of production, and making plans to provide these resources. Open shop orders, as will as planned orders in the MRP system, are input to CRP which "translates" these orders into hours of work by work center by time period. In earlier years, the computer portion of CRP was called "infinite loading," a misnomer.

CLOSED LOOP MRP: A system built around material requirements planning and also including the additional planning functions of production planning, master production scheduling, and capacity requirements planning. Further, once the planning phase is complete and the plans have been accepted as realistic and attainable, the execution functions come into play. These include the shop floor control functions of input/output measurement, dispatching, plus anticipated delay reports from both the shop and vendors, vendor scheduling, etc. The term "closed loop" implies that not only is each of these elements included in the overall system but also that there is feedback from the execution functions so that the planning can be kept valid at all times.

COMMON PARTS BILL (OF MATERIAL): A type of planning bill which groups all common components for a product or family of products into one bill of material.

CUMULATIVE LEAD TIME: The longest length of time involved to accomplish the activity in question. For any item planned through MRP it is found by reviewing each bill of material path below the item, and whichever path adds up to the greatest number defines cumulative material lead time. Also called aggregate lead time, stacked lead time, composite lead time, critical path lead time.

CYCLE COUNTING: A physical inventory-taking technique where inventory is counted on a periodic schedule rather than once a year. For example, a cycle inventory count may be taken when an item reaches its reorder point, when new stock is received, or on a regular basis usually more frequently for high-value fast-moving items and less frequently for low-value or slow-moving items. Most effective cycle counting systems require the counting of a certain number of items every work day.

DEMAND MANAGEMENT: The function of recognizing and managing all of the demands for products to ensure that the master scheduler is aware of them. It encompasses the activities of forecasting, order entry, order promising, branch warehouse requirements, interplant requirements, interplant orders, and service parts requirements.

DEMONSTRATED CAPACITY: Capacity calculated from actual performance data, usually number of items produced times standard hours per item plus the standard set-up time for each job.

DEPENDENT DEMAND: Demand is considered dependent when it comes from production schedules for other items. These demands should be calculated, not forecasted. A given item may have both dependent and independent demand at any given time. See Independent Demand.

FINITE LOADING: Conceptually, the term means putting no more work into a work center than it can be expected to execute. The specific term usually refers to a computer technique that involves automatic shop priority revision in order to level load operation-by-operation. Successful applications of finite loading are very difficult to find.

FIRM PLANNED ORDER: A planned order that can be frozen in quantity and time. The computer is not allowed to change it; this is the responsibility of the planner in charge of the item. This technique can aid planners to respond to material and capacity problems by firming up selected planned orders. Firm planned orders are also the normal method of stating the master production schedule.

INDEPENDENT DEMAND: Demand for an item is considered independent when such demand is unrelated to the demand for other items. Demand for finished goods and service parts are examples of independent demand.

INPUT/OUTPUT CONTROL: A technique for capacity control where actual output from a work center is compared with the planned output (as developed by CRP and approved by Manufacturing). The input is also monitored to see if it corresponds with plans so that work centers will not be expected to generate output when jobs are not available to work on.

ITEM RECORD: The "master" record for an item. Typically it contains identifying and descriptive data, control values (lead times, lot order quantities, etc.) and may contain data on inventory status, requirements, and planned orders. Item records are linked together by bill of material records (or product structure record), thus defining the bill of material.

JOB SHOP: A functional organization whose departments or work centers are organized around particular types of equipment or operations, such as drilling, forging, spinning, or assembly. Products move through departments by individual shop orders.

LEAD TIME: A span of time required to perform an activity. In a logistics context, the activity in question is normally

the procurement of materials and/or products either from an outside supplier or from one's own manufacturing facility. The individual components of any given lead time can include some or all of the following: order preparation time, queue time, move or transportation time, receiving and inspection time.

LEVEL: Every part of assembly in a product structure is assigned a level code signifying the relative level in which that part or assembly is used within that product structure. Normally, the end items are assigned level "0" and the components/subassemblies going into it are level "1" and so on. The MRP explosion process starts from level "0" and proceeds downwards one level at a time.

LOT-FOR-LOT: An order quantity technique in MRP which generates planned orders in quantities equal to the net requirements in each period. Also called discrete, one-for-one.

MAKE-TO-ORDER PRODUCT: The end item is finished after receipt of a customer order. Frequently, long lead-time components are planned prior to customer orders arriving in order to reduce the delivery time to the customer. Where options or other subassemblies are stocked prior to customer orders arriving, the term "assemble-to-order" is frequently used.

MAKE-TO-STOCK PRODUCT: The end item is shipped from finished goods "off the shelf," and therefore, is finished prior to a customer order arriving.

MANUFACTURING RESOURCE PLANNING (MRP II): A method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has a simulation capability to answer "what if" questions. It is made up of a variety of functions, each linked together: business planning, production planning, master production scheduling, material requirements planning, capacity requirements planning and the execution support systems for capacity and material. Output from these systems would be integrated with financial reports such as the business plan, purchase commitment reports, shipping budget, inventory projections in dollars, etc. Manufacturing Resource Planning is a direct outgrowth and extension of closed loop MRP. MRP II has also been defined, validly, as a management system based on network scheduling. Also, and perhaps best, as organized common sense.

MASTER PRODUCTION SCHEDULE (MPS): The anticipated build schedule. The master scheduler maintains this schedule and, in turn, it becomes a set of planning numbers which "drives" MRP. It represents what the company plans to produce expressed in specific configurations, quantities and dates. The master production schedule must take into account customer orders and forecasts, backlog, availability of material, availability of capacity, management policy and goals, etc.

NET CHANGE MRP: A method of processing material requirements planning on the computer whereby the material plan is continually retained in the computer. Whenever there is a change in requirements, open order or inventory status, bills of material, etc., a partial explosion is made only for those parts affected by the change.

NET REQUIREMENTS: In MRP, the net requirements for a part or an assembly are derived as a result of netting gross requirements against inventory on hand and scheduled receipts. Net requirements, lot sized and offset for lead time, become planned orders.

ORDER PROMISING: The process of making a delivery commitment, i.e., answering the question "When can you ship?" For make-to-order products, this usually involves a check of material and capacity availability.

PEGGING: In MRP, pegging displays, for a given item, the details of the sources of its gross requirements and/or allocations. Pegging can be thought of as "live" where-used information.

PLANNED ORDER: A suggested order quantity and due date created by MRP processing, when it encounters net requirements. Planned orders are created by the computer, exist only within the computer, and may be changed or deleted by the computer during subsequent MRP processing if conditions change. Planned orders at one level will be exploded into gross requirements for components at the next lower level. Planned orders also serve as input to capacity requirements planning, along with scheduled receipts, to show the total capacity requirements in future time periods.

PRODUCT PLANNING: The function of setting the overall level of manufacturing output. Its prime purpose is to establish production rates that will achieve management's objective in terms of raising or lowering inventories or backlogs, while usually attempting to keep the production force relatively

stable. The production plan is usually stated in broad terms (e.g., product groupings, families of products). It must extend through a planning horizon sufficient to plan the labor, equipment, facilities, material and finances required to accomplish the production plan. Various units of measure are used by different companies to express the plan such as standard hours, tonnage, labor operators, units, pieces, etc. As this plan affects all company functions, it is normally prepared with information from marketing, manufacturing, engineering, finance, materials, etc. In turn, the production plan becomes management's authorization for the master scheduler to convert into a more detailed plan.

REGENERATION MRP: A method of processing material requirements planning on the computer whereby the master production schedule is totally re-exploded down through all bills of material, at least once per week to maintain valid priorities. New requirements and planned orders are completely "regenerated" at that time.

RESCHEDULING ASSUMPTION: A fundamental piece of MRP logic which assumes that existing open orders can be rescheduled in nearer time periods far more easily than new orders can be released and received. As a result, planned order receipts are not created until all scheduled receipts have been applied to cover gross requirements.

ROUGH-CUT CAPACITY PLANNING: The process of converting the production plan and/or master production schedule into capacity needs for key resources: manpower, machinery, warehouse space, vendors' capabilities and in some cases, money. Product load profiles are often used to accomplish this. The purpose of rough-cut capacity planning is to evaluate the plan prior to attempting to implement it. Sometimes called resource requirements planning.

ROUTING: A document detailing the manufacture of a particular item. It includes the operations to be performed, their sequence, the various work centers to be involved, and the standards for set-up and run. In some companies, the routing also includes information on tooling, operator skill levels, inspection operations, testing requirements, etc.

SAFETY STOCK: In general, a quantity of stock planned to be available to protect against fluctuations in demand and/or supply.

SCHEDULED RECEIPTS: Within MRP, open production orders and open purchase orders are considered as "scheduled receipts" on their due date and will be treated as part of available inventory during the netting process for the time period in question. Scheduled receipt dates and/or quantities are not normally altered automatically by the computer. Further, scheduled receipts are not exploded into requirements for components, as MRP logic assumes that all components required for the manufacture of the item in question have either been allocated or issued to the shop floor.

SIMULATION: Within MRP II, using the operational date to perform "what-if" evaluations of alternative plans, to answer "Can we do it?" If yes, the simulation can then be run in financial mode to help answer the question "Do we really want to?"

TIME BUCKET: A number of days of data summarized into one columnar display. A weekly time bucket in MRP would contain all the relevant planning data for an entire week. Weekly time buckets are considered to be the largest possible (at least in the near-and medium-term) to permit effective MRP.

Appendix B: Interview Instrument

Part I: Personal and General Information, MAN Personnel

Date:_____ Phone #: (____)_____-_____

Rank/Name:_____
Duty
Title:_____
_____

Location:_____
Years MRP/MRP II Experience:_____

Years AFLC/ALC Experience:_____

Part II: Questions for MAN Personnel

A. Management Support

1. To what degree does top management support this project?

2. What priority is MRP II implementation relative to other ongoing activities in the organization? Has this position been constant?

3. Is top management support visible at every level of the organization? If so, in what ways? If not, why?

4. What does top management expect from the MRP II implementation project? MRP II in general?

5. What evidence is there of management support? (Commitment of resources, resource concessions to training, etc.)

6. Is there a steering committee? To whom do they report?

7. Is there a project champion? If so, at what level of the organization?

B. Education

1. What is the MRP II education plan and who has/will receive the education? (On-site, off-site, in house, contractor)

2. What priority does education have in the overall implementation plan?

3. How many personnel need education? Training?

4. How much education has been done to date? Training?

5. What percentage of personnel will be educated by the implementation date? Trained?

6. What problems do you expect or did you encounter in education? Training? (Time, facilities, instructors, receptiveness of the students)

7. Who will conduct education classes for each level? Training? (On-site, off-site)

8. What percentage/portion of the implementation costs is education? Training? (Initial, continuing)

9. What is the personnel turnover rate in your division?

10. What is the level of involvement with the local APICS chapter? (Certification, education)

11. Who will do the training? (Continuing, initial)

12. What is the level of involvement with AFIT's continuing education faculty?

13. To what extent do all personnel understand the concepts of MRP II?

C. Project Implementation Team

1. How many full time personnel are assigned to the team?

2. How much turnover is there on the team?

3. Where did the team members come from? (Inside or outside the organization)

4. Which functional areas are represented on the team? Which are missing?

5. What is their acccuntability?

D. Change Management

1. What steps were/are being taken to prepare personnel for the change to MRP II?

2. What problems do you anticipate during transition?

3. What scheduling changes have been made as a result of the transition?

4. Are there any chronic "change resistors" and if so, what is being done about them?

5. What are the expectations for success in MAN? At OOALC? At all ALCs?

6. What is the impact of success or failure at MAN on subsequent implementers?

E. Data Accuracy

1. What techniques were/will be used to develop BOMs for products whose component repair requirements are not deterministic?

2. What is the BOM accuracy?

3. What are the goals for BOM accuracy?

4. How is BOM accuracy measured? Has it changed?

5. What happens when there is a change to the BOM?

6. What techniques are/will be used to achieve and maintain inventory accuracy?

7. What portion of the inventory is cycle counted? (Goal?)

8. What is current inventory accuracy and how is it measured? (Goal?)

9. What is being done to simplify inventory processing actions? (bar coding, paperless accounting)

10. How are lead times computed? (Deterministic vs. stochastic)

11. How will safety stock be used?

12. Where will inventory status be maintained?

F. Pilot Program

1. Will a pilot program be used within the division prior to full cut-over?

2. If so, what section was chosen and why?

3. Describe the implementation plan for this division from now until "turn-on."

Part I: Personal and General Information, OOALC (Non-MAN) Personnel

Date:_____ Phone #: (____)_____-_____

Rank/Name:_____
Duty
Title:_____

_____

Location:_____

Years MRP/MRP II Experience:_____

Years AFLC/ALC Experience:_____

Part II: Questions for OOALC (Non-MAN) Personnel

A. Management Support

1. To what degree does top management support this project?

2. What priority is MRP II implementation relative to other ongoing activities in the organization? Has this position been constant?

3. Is top management support visible at every level of the organization? In what ways?

4. What does top management expect from the MRP II implementation project? MRP II in general?

5. What evidence is there of management support? (Commitment of resources, resource concessions to training, etc.)

6. Is there a steering committee? To whom do they report?

7. Is there a project champion? If so, at what level of the organization?

B. Education

1. What is the MRP II education plan and who has/will receive the education? (On-site, off-site, in house, contractor)

2. What priority does education have in the overall implementation plan?

3. How many personnel need education? Training?

4. How much education has been done to date? Training?

5. What percentage of personnel will be educated by the implementation date? Trained?

6. What problems do you expect or did you encounter in education? Training? (Time, facilities, instructors, receptiveness of the students)

7. Who will conduct education classes for each level? Training? (On-site, off-site)

8. What percentage/portion of the implementation costs is education? Training? (Initial, continuing)

9. What is the personnel turnover rate in your division?

10. What is the level of involvement with the local APICS chapter? (Certification, education)

11. Who will do the training? (Continuing, initial)

12. What is the level of involvement with AFIT's continuing education faculty?

13. To what extent do all personnel understand the concepts of MRP II?

C. Project Implementation Team

1. How many full time personnel are assigned to the team?

2. How much turnover is there on the team?

3. Where did the team members come from? (Inside or outside the organization)

4. Which functional areas are represented on the team? Which are missing?

5. What is their accountability?

D. Change Management

1. What steps were/are being taken to prepare personnel for the change to MRP II?

2. What problems do you anticipate during cut-over?

3. What scheduling changes have been made as a result of the cut-over?

4. Are there any chronic "change resistors" and if so, what is being or will be done about them?

5. What are the expectations for success in MAN? At OOALC? At all ALCs?

6. What is the impact of success or failure at MAN on subsequent implementers?

E. Data Accuracy

1. What techniques were/will be used to develop BOMs for products when requirements are not deterministic?

2. What is the present BOM accuracy?

3. What are the goals for BOM accuracy?

4. How is BOM accuracy measured? Has the measure changed?

5. What happens when there is a change to the BOM?

6. What techniques are/will be used to achieve and maintain inventory accuracy?

7. What portion of the inventory is cycle counted? (Goal?)

8. What is current inventory accuracy and how is it measured? (Goal?)

9. What is being done to simplify inventory processing actions? (bar coding, paperless accounting)

10. How are lead times computed? (Deterministic vs. stochastic)

11. How will safety stock be used?

12. Where will inventory status be maintained?

F. Pilot Program

1. Will a pilot program be used within the division prior to full transition?

2. If so, what section will pilot and why?

3. Describe the implementation plan for this division from now until "turn-on."

Part I: Personal and General Information, Non-OOALC Personnel

Date:_____ Phone #: (____)_____-_____

Rank/Name:_____
Duty
Title:_____
_____
Location:_____
Years MRP/MRP II Experience:_____

Years AFLC/ALC Experience:_____

Part II: Questions for Non-OOALC Personnel

A. Management Support

1. To what degree does top management support this project?

2. What priority is MRP II implementation relative to other ongoing activities in the organization? Has this position been constant?

3. Is top management support visible at every level of the organization? In what ways?

4. What does top management expect from the MRP II implementation project? MRP II in general?

5. What evidence is there of management support? (Commitment of resources, resource concessions to training, etc.)

6. Is there a steering committee? To whom do they report?

7. Is there a project champion? If so, at what level of the organization?

B. Education

1. What is the MRP II education plan and who has/will receive the education? (On-site, off-site, in house, contractor)

2. What priority does education have in the overall implementation plan?

3. How many personnel need education? Training?

4. How much education has been done to date? Training?

5. What percentage of personnel will be educated by the implementation date? Trained?

6. What problems do you expect or did you encounter in education? Training? (Time, facilities, instructors, receptiveness of the students)

7. Who will conduct education classes for each level? Training? (On-site, off-site)

8. What percentage/portion of the implementation costs is education? Training? (Initial, continuing)

9. Who will do the training? (Continuing, initial)

10. What is the level of involvement with AFIT's continuing education faculty?

11. To what extent do all personnel understand the concepts of MRP II?

C. Project Implementation Team

1. How many full time personnel are assigned to the team?

2. How much turnover is there on the team?

3. Where did the team members come from? (Inside or outside the organization)

4. Which functional areas are represented on the team? Which are missing?

5. What is their accountability?

D. Change Management

1. What steps were/are being taken to prepare personnel for the change to MRP II?

2. What problems do you anticipate during transition?

3. What scheduling changes have been made as a result of the transition?

4. Are there any chronic "change resistors" and if so, what is being or will be done about them?

5. What are the expectations for success in MAN? At OOALC? At all ALCs?

6. What is the impact of success or failure in MAN on subsequent implementers?

E. Data Accuracy

1. What techniques were/will be used to develop BOMs when requirements are not deterministic?

2. What is the present BOM accuracy?

3. What are the goals for BOM accuracy?

4. How is BOM accuracy measured? Has the measure changed?

5. What happens when there is a change to the BOM?

6. What techniques are/will be used to achieve and maintain inventory accuracy?

7. What portion of the inventory is cycle counted? (Goal?)

8. What is current inventory accuracy and how is it measured? (Goal?)

9. What is being done to simplify inventory processing actions? (bar coding, paperless accounting)

10. How are lead times computed? (Deterministic vs. stochastic)

11. How will safety stock be used?

12. Where will inventory status be maintained?

F. Pilot Program

1. Will a pilot program be used within each division prior to full cut-over?

2. If so, how will the sections be selected?

3. Describe the implementation plan from now until full system "turn-on."

Appendix C: Employee Attitude Questionnaire for Long Term Success Inference and Longitudinal Study

This questionnaire is adapted from "How to Evaluate Your MRP System," Production and Inventory Management, 3: 29-34 (Third Quarter, 1982).

The attitude questionnaire is to be administered to management, users, and system personnel involved with the MRP system. The term "management" refers to those having a macro view of the system. The user group consists of employees involved with the MRP system on a micro level, i.e., those who supply and receive day-to-day information in performing their job. The system group includes the system analysts and programmers responsible for designing, implementing, operating and maintaining the MRP system.

The questionnaire consists of the following sections:

1. Support of the System/ Resistance to Change,
2. Communication Between Management, the User, and Data Processing,
3. Qualified Personnel/User Education,
4. User Participation in System Design, and
5. Complexity of Design.

AFIT Form 11E is used to complete the questionnaire. The cover letter and questionnaire are on the following pages.

AFIT/LS (Capt Faulkner, 255-6569)
Date

Research Questionnaire

Questionnaire Respondent

1. Please complete the attached questionnaire. It should take no more than five minutes and your responses will be completely anonymous. When you have finished, please place the document in the attached envelope.

2. I am a graduate student studying the implementation of MRP II at the Ogden ALC. A critical part of this effort is determining the attitudes at various levels of the organization. Your assistance will further expand the knowledge base in this area and may allow others to benefit from your knowledge and experience.

3. Your participation is voluntary, however completion and return of the questionnaire within the next week would be greatly appreciated. Please feel free to me, Capt John Faulkner, at AV 758-6569/5435 if you have any questions about this questionnaire.

JOHN M. FAULKNER, Capt, USAF
Graduate Student
AFIT/LSG

Please use a #2 pencil on the accompanying computer scoring form. Read each statement carefully and circle one number only, depending upon how you react to the individual statement.

1. Please indicate your organization.

1. OOALC/MAN 2. OOALC/MAB 3. OOALC/MAK
4. OOALC/other 5. HQ AFLC/MA-4
6. HQ AFLC/other 7. other

2. Into which of the following groups do you fall?

1. Management (use only secondary MRP information derived from user information).

2. User (involved with the MRP system at the primary level, supply and receive day-to-day information in performing your job).

3. System (responsible for designing, implementing, operating, and maintaining the MRP system).

4. Other

For the remaining questions use the following scale:

1-STRONGLY AGREE (S.A.)
2-AGREE
3-SLIGHTLY AGREE
4-SLIGHTLY DISAGREE
5-DISAGREE
6-STRONGLY DISAGREE (S.D.)

		S.A.					S.D.
3.	MRP changes the organization's power structure.	1	2	3	4	5	6
4.	MRP changes social relations within the work environment.	1	2	3	4	5	6
5.	MRP requires unlearning old work methods and acquiring new work methods.	1	2	3	4	5	6
6.	Top management supports MRP.	1	2	3	4	5	6

1-STRONGLY AGREE (S.A) 2-AGREE 3-SLIGHTLY AGREE
4-SLIGHTLY DISAGREE 5-DISAGREE 6-STRONGLY DISAGREE
(S.D.)

		S.A.					S.D.
7.	MRP requires me to make decisions on a formalized basis with little individual discretion.	1	2	3	4	5	6
8.	MRP aids others more than myself.	1	2	3	4	5	6
9.	MRP is more useful than the previous system.	1	2	3	4	5	6
10.	MRP will work in our organization	1	2	3	4	5	6
11.	MRP requires new personal relationships that are uncomfortable for me.	1	2	3	4	5	6
12.	The goals of MRP aid me in the achievement of my personal goals.	1	2	3	4	5	6
13.	I need the information MRP provides.	1	2	3	4	5	6
14.	The computer was introduced to replace people.	1	2	3	4	5	6
15.	The previous system controlled as well as MRP.	1	2	3	4	5	6
16.	The MRP system enables me to perform my job better.	1	2	3	4	5	6
17.	The MRP system has produced stress between certain areas of the organization.	1	2	3	4	5	6
18.	The users are capable of communicating their information needs to the MRP design team.	1	2	3	4	5	6
19.	The MRP design team understands the users' functions.	1	2	3	4	5	6
20.	Data processing has a higher position in the organization than the users.	1	2	3	4	5	6

1-STRONGLY AGREE (S.A) 2-AGREE 3-SLIGHTLY AGREE
4-SLIGHTLY DISAGREE 5-DISAGREE 6-STRONGLY DISAGREE
(S.D.)

		S.A.					S.D.
21.	Data processing lacks a technical understanding of the work process.	1	2	3	4	5	6
22.	There is a gap in the levels of formal education between users and data processing.	1	2	3	4	5	6
23.	The users were able to explain their information needs to the systems analysts.	1	2	3	4	5	6
24.	Reports are tailored to the users' needs.	1	2	3	4	5	6
25.	MRP system users have little computer experience.	1	2	3	4	5	6
26.	The personnel on the MRP design team have a low turnover rate.	1	2	3	4	5	6
27.	Too many people are on the MRP design team.	1	2	3	4	5	6
28.	The users on the MRP design team are knowledgeable about the operations of the organization.	1	2	3	4	5	6
29.	The users of the MRP system feel free to criticize the system's performance.	1	2	3	4	5	6
30.	There is conflict between user values, management values, and data processing values.	1	2	3	4	5	6
31.	The users' ideas are seriously evaluated.	1	2	3	4	5	6
32.	Personal conflict exists between users, data processing, and management.	1	2	3	4	5	6
33.	The MRP system users make decisions based on the reported information.	1	2	3	4	5	6

1-STRONGLY AGREE (S.A) 2-AGREE 3-SLIGHTLY AGREE
4-SLIGHTLY DISAGREE 5-DISAGREE 6-STRONGLY DISAGREE
(S.D.)

		S.A.					S.D.
34.	The MRP system users understand MRP concepts and operating details.	1	2	3	4	5	6
35.	The MRP system designers understand the users' information needs.	1	2	3	4	5	6
36.	The MRP system users have confidence in the systems design.	1	2	3	4	5	6
37.	The MRP system designers possess computer expertise and creative ability.	1	2	3	4	5	6
38.	I understand my duties with respect to the MRP system.	1	2	3	4	5	6
39.	I understand other MRP users' duties.	1	2	3	4	5	6
40.	Management does not understand the requirements of my MRP system duties.	1	2	3	4	5	6
41.	Some of the MRP systems reports I receive are difficult to understand.	1	2	3	4	5	6
42.	I have above-average knowledge in computer information systems.	1	2	3	4	5	6
43.	The MRP system generates more information than I can use.	1	2	3	4	5	6
44.	Most of my knowledge about our MRP system came from on-the-job experience rather than formal training sessions.	1	2	3	4	5	6
45.	The MRP system requires much more of my time than it does the other users.	1	2	3	4	5	6
46.	There is a continuous educational program to educate users with respect to the MRP system and changes made to it.	1	2	3	4	5	6
47.	I helped in the design of the MRP system.	1	2	3	4	5	6
48.	I am satisfied with the MRP system.	1	2	3	4	5	6

1-STRONGLY AGREE (S.A) 2-AGREE 3-SLIGHTLY AGREE
4-SLIGHTLY DISAGREE 5-DISAGREE 6-STRONGLY DISAGREE (S.D.)

		S.A.					S.D.
49.	The reports of the MRP system are in an easy to use format.	1	2	3	4	5	6
50.	Participation in MRP design placed many hardships on my department.	1	2	3	4	5	6
51.	The MRP users in my department do not work well with the MRP system design team.	1	2	3	4	5	6
52.	The MRP users continually review the performance and report needs of the system.	1	2	3	4	5	6
53.	The MRP users had several options to choose from during the design stage.	1	2	3	4	5	6
54.	The users' information needs have been completely identified.	1	2	3	4	5	6
55.	The major user design task involved the report formats.	1	2	3	4	5	6
56.	Positive results can be attributed to my efforts in the system design.	1	2	3	4	5	6
57.	The bulk of the design effort was the responsibility of the information systems specialist.	1	2	3	4	5	6
58.	I had little knowledge of MRP theory when the system's design took place.	1	2	3	4	5	6
59.	The users designed the data entry procedures for reporting MRP transactions.	1	2	3	4	5	6
60.	My department was adequately represented on the design team.	1	2	3	4	5	6
61.	Design of the MRP system required little of my time or effort.	1	2	3	4	5	6
62.	Adequate time was allowed for the design of the MRP system.	1	2	3	4	5	6

1-STRONGLY AGREE (S.A) 2-AGREE 3-SLIGHTLY AGREE
4-SLIGHTLY DISAGREE 5-DISAGREE 6-STRONGLY DISAGREE
(S.D.)

		S.A.					S.D.
63.	MRP is a significant change from the previous manufacturing control system.	1	2	3	4	5	6
64.	MRP is difficult to implement.	1	2	3	4	5	6
65.	This organization's MRP system is an ambitious design.	1	2	3	4	5	6
66.	The MRP system is simple and easy to understand.	1	2	3	4	5	6
67.	The MRP system is growing in complexity.	1	2	3	4	5	6
68.	The MRP system is easy to use.	1	2	3	4	5	6
69.	The MRP system is flexible in its design.	1	2	3	4	5	6
70.	The MRP system cannot provide information on a timely basis.	1	2	3	4	5	6
71.	It is difficult to report transactions of the operations on a timely enough basis to provide control.	1	2	3	4	5	6
72.	The MRP system was designed with clearly defined objectives.	1	2	3	4	5	6
73.	The initial MRP design was simplified to make implementation easier.	1	2	3	4	5	6
74.	The information I need to perform my my job is lost among excessive information.	1	2	3	4	5	6
75.	A complex system has a better chance for becoming successful.	1	2	3	4	5	6
76.	Frequent reporting of exception messages is an unfortunate necessity of an MRP system.	1	2	3	4	5	6

Appendix D: The ABCD Checklist

This checklist is taken from Manufacturing Resource Planning: MRP II: Unlocking America's Productivity Potential by Oliver Wight (40).

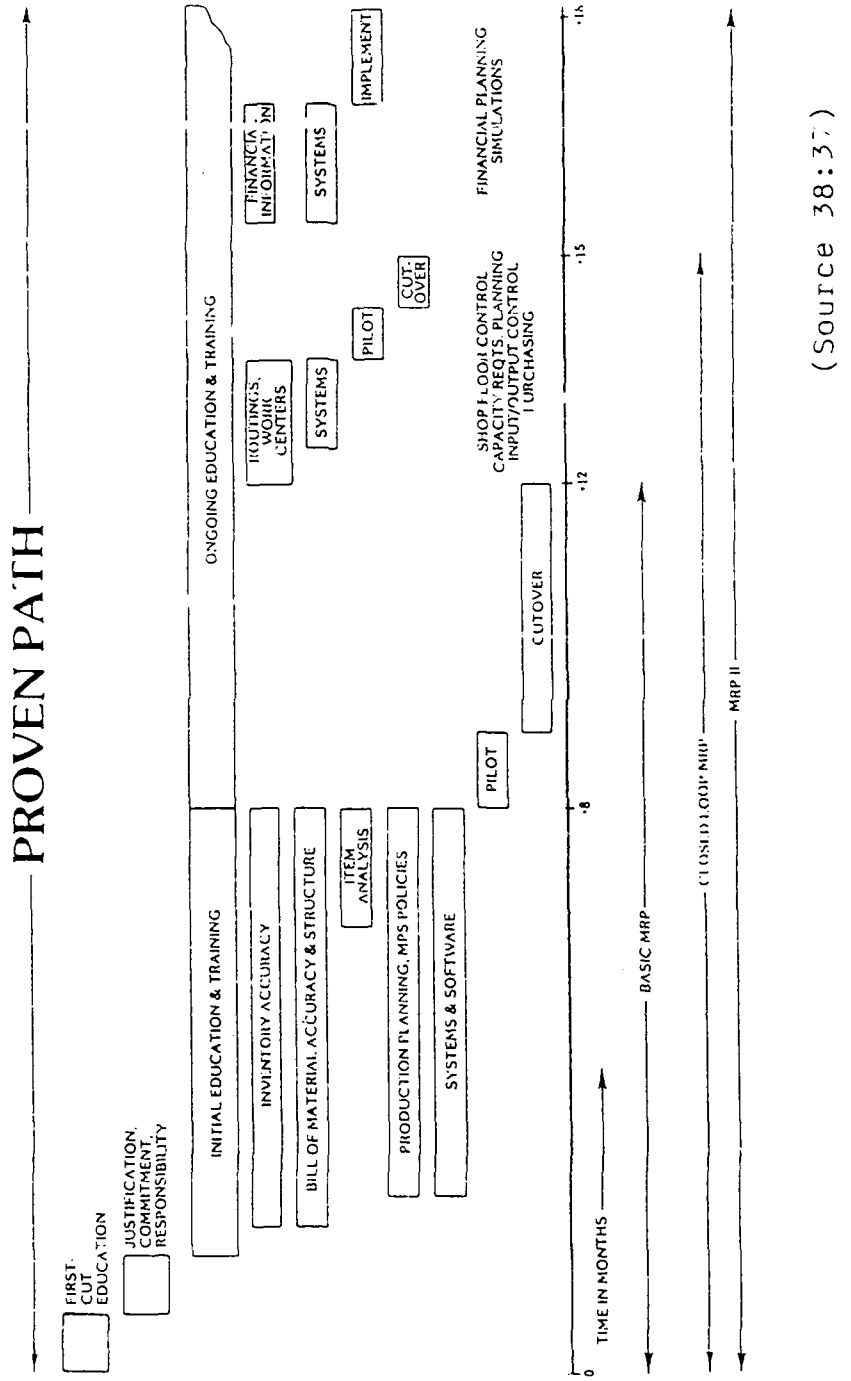
	YES	NO
Technical		
1. Time periods for master production scheduling and Material Requirements Planning are weeks or smaller.	____	____
2. Master production scheduling and Material Requirements Planning run weekly or more frequently.	____	____
3. System includes firm planned order and pegging capability.	____	____
4. The master production schedule is visibly managed, not automatic.	____	____
5. System includes capacity requirements planning.	____	____
6. System includes daily dispatch list.	____	____
7. System includes input/output control.		
Data Integrity		
8. Inventory record accuracy 95% or better.	____	____
9. Bill of material accuracy 98% or better.	____	____
10. Routing accuracy 95% or better.	____	____
Education		
11. Initial education of at least 80% of all employees.	____	____
12. An ongoing education program.	____	____

Use of the System	YES	NO
13. The shortage list has been eliminated.	____	____
14. Supply delivery performance is 95% or better.	____	____
15. Supply scheduling is done beyond the quoted lead times.	____	____
16. Shop delivery performance is 95% or better.	____	____
17. Master schedule performance is 95% or better.	____	____
18. There are regular (or at least monthly) production planning meetings with the division chief and staff concerning MRP II operation.	____	____
19. There is a written master scheduling policy which is adhered to.	____	____
20. The system is used for scheduling as well as ordering.	____	____
21. MRP is well understood by key people in all areas of operations.	____	____
22. Management really uses MRP to manage.	____	____
23. Engineering changes are effectively implemented.	____	____
24. Simultaneous improvement has been achieved in at least two of the following three areas: inventory, productivity, customer service.	____	____
25. Operating system is used for financial planning.	____	____

Evaluate where the organization stands in each of the areas identified. Total the yes answers and multiply by four. In some instances partial credit is warranted and an appropriate portion of the four points per question should be awarded. Determine the current class level using the following scale:

90-100	Class A
70- 90	Class B
50- 70	Class C
Below 50	Class D

Appendix E: The Path to Implementation



(Source 38:37)

Appendix F: SPSS-X Programs for Category Determination

This appendix contains the SPSS-X programs used to differentiate category groupings with a Chi-Square test.

Management Support, Key: Question 6

```
Title           'Questionnaire Analysis'
File Handle     John/name='mrp.dat'
Data List       File=John fixed records=2/
                ID Q1 to Q76
                (1f8.0,1x,71f1.0/9x,5f1.0)
Set             Blanks=99
Missing Values  Q1 to Q76 (99)
Recode          Q3 to Q76 (7=99)
Value Labels    Q1 1 'MAN' 2 'MAB' 3 'MAK' 4 'Other ALC' 5
                  'MA4' 6 'HQ' 7 'Other'
Crosstabs       Tables=Q3 to Q76 by Q6/Statistics=all
finish
```

Likelihood of Success, Key: Question 10

```
Title           'Questionnaire Analysis'
File Handle     John/name='mrp.dat'
Data List       File=John fixed records=2/
                ID Q1 to Q76
                (1f8.0,1x,71f1.0/9x,5f1.0)
Set             Blanks=99
Missing Values  Q1 to Q76 (99)
Recode          Q3 to Q76 (7=99)
Value Labels    Q1 1 'MAN' 2 'MAB' 3 'MAK' 4 'Other ALC' 5
                  'MA4' 6 'HQ' 7 'Other'
Crosstabs       Tables=Q3 to Q76 by Q10/Statistics=all
finish
```

Impact on the Organization, Key: Question 32

```
Title           'Questionnaire Analysis'
File Handle     John/name='mrp.dat'
Data List       File=John fixed records=2/
                ID Q1 to Q76
                (1f8.0,1x,71f1.0/9x,5f1.0)
Set             Blanks=99
Missing Values  Q1 to Q76 (99)
Recode          Q3 to Q76 (7=99)
Value Labels    Q1 1 'MAN' 2 'MAB' 3 'MAK' 4 'Other ALC'
5                 'MA4' 6 'HQ' 7 'Other'
Crosstabs       Tables=Q3 to Q76 by Q32/Statistics=all
finish
```

Understanding of MRP, Key: Question 38

```
Title           'Questionnaire Analysis'
File Handle     John/name='mrp.dat'
Data List       File=John fixed records=2/
                ID Q1 to Q76
                (1f8.0,1x,71f1.0/9x,5f1.0)
Set             Blanks=99
Missing Values  Q1 to Q76 (99)
Recode          Q3 to Q76 (7=99)
Value Labels    Q1 1 'MAN' 2 'MAB' 3 'MAK' 4 'Other ALC' 5
              'MA4' 6 'HQ' 7 'Other'
Crosstabs       Tables=Q3 to Q76 by Q38/Statistics=all
finish
```

Appendix G: Question Categorization

This appendix contains the grouping of questions by category used in questionnaire analysis.

Management Support

Key Question: 6

Questions in category: 6, 10, 14, 29, 31, 36, 37, 40, 58, 64

Understanding of MRP

Key Question: 38

Questions in category: 3, 7, 10, 12, 25, 28, 33, 34, 38, 39, 40, 42, 43, 45, 46, 47, 48, 49, 50, 52, 53, 54, 56, 58, 60, 61, 63, 65, 66, 67, 68, 69, 70

Likelihood of Success

Key Question: 10

Questions in category: 3, 6, 9, 10, 12, 13, 14, 15, 16, 18, 19, 21, 23, 24, 26, 27, 28, 33, 34, 35, 36, 38, 39, 40, 43, 47, 48, 49, 54, 56, 63, 67, 69, 70, 71, 72, 73, 74, 75

Impact of Implementation

Key Question: 32

Questions in category: 7, 11, 12, 17, 18, 19, 20, 21, 22, 23, 29, 30, 31, 32, 34, 40, 41, 42, 43, 45, 46, 48, 52, 53, 54, 55, 57, 59, 60, 62, 63, 65, 66, 67, 68, 69, 71, 75

Appendix H: Frequencies by Question

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze question frequencies for the entire sample.

SPSS-X Program

```
1  0  Title            'Questionnaire Analysis'
2  0  File Handle      John/name='mrp.dat'
3  0  Data List        File=John fixed records=2/
4  0                   ID Ques1 to Ques76
5  0                   (1f8.0,1x,71f1.0/9x,5f1.0)

THE COMMAND ABOVE READS   2 RECORDS FROM mrp.dat

6  0  Set              Blanks=99
7  0  Missing Values  Ques1 to Ques76 (99)
8  0  Recode           Ques3 to Ques76 (7=99)
9  0  Frequencies      Variables=Ques1 to Ques76/
                       statistics=all
```

Sample Output

QUES1

VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
1	56	37.8	38.6	38.6
2	64	43.2	44.1	82.8
4	11	7.4	7.6	90.3
5	8	5.4	5.5	95.9
6	5	3.4	3.4	99.3
7	1	.7	.7	100.0
99	3	2.0	MISSING	
TOTAL	148	100.0	100.0	

MEAN	2.103	STD ERR	.115	MEDIAN	2.000
MODE	2.000	STD DEV	1.383	VARIANCE	1.913
KURTOSIS	1.915	S E KURT	.400	SKEWNESS	1.617
S E SKEW	.201	RANGE	6.000	MINIMUM	1.000
MAXIMUM	7.000	SUM	305.000		
VALID CASES	145	MISSING CASES	3		

QUES2

VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
1	25	16.9	17.2	17.2
2	51	34.5	35.2	52.4
3	35	23.6	24.1	76.6
4	34	23.0	23.4	100.0
99	3	2.0	MISSING	
TOTAL	148	100.0	100.0	

MEAN	2.538	STD ERR	.086	MEDIAN	2.000
MODE	2.000	STD DEV	1.034	VARIANCE	1.070
KURTOSIS	-1.159	S E KURT	.400	SKEWNESS	.069
S E SKEW	.201	RANGE	3.000	MINIMUM	1.000
MAXIMUM	4.000	SUM	368.000		
VALID CASES	145	MISSING CASES	3		

Appendix I: Category Frequencies, Controlling for Organization

This appendix contains four SPSS-X programs and a summary of output. The output was used to analyze each category's response frequency by organization.

Organization 1: MAN

```
    1   0  Title            'Questionnaire Analysis'
    2   0  File Handle      John/name='mrp.dat'
    3   0  Data List        File=John fixed records=2/
    4   0                   ID Q1 to Q76
    5   0                   (1f8.0,1x,71f1.0/9x,5f1.0)
 THE COMMAND ABOVE READS    2 RECORDS FROM mrp.dat
    6   0  Set              Blanks=99
    7   0  Missing Values   Q1 to Q76 (99)
    8   0  Recode           Q3 to Q76 (7=99)
    9   0  Compute          MS=Q6+Q10+Q14+Q29+Q31+Q36+Q37+Q40
                            +Q58+Q64
   10   0  Compute          UND=Q3+Q7+Q10+Q12+Q25+Q28+Q33+Q34
                            +Q38+Q39+Q40+Q42/
   11   0                   +Q43+Q45+Q46+Q47+Q48+Q49+Q50+Q52
                            +Q53+Q54+Q56+Q58/
   12   0                   +Q60+Q61+Q63+Q65+Q66+Q67+Q68+Q69
                            +Q70
   13   0  Compute          SUC=Q3+Q6+Q9+Q10+Q12+Q13+Q14+Q15
                            +Q16+Q18+Q19+Q21/
   14   0                   +Q23+Q24+Q26+Q27+Q28+Q33+Q34+Q35
                            +Q36+Q38+Q39+Q40/
   15   0                   +Q43+Q47+Q48+Q49+Q54+Q56+Q63+Q67
                            +Q69+Q70+Q71+Q72/
   16   0                   +Q73+Q74+Q75
   17   0  Compute          IMP=Q7+Q11+Q12+Q17+Q18+Q19+Q20
                            +Q21+Q22+Q23+Q29+Q30/
   18   0                   +Q31+Q32+Q34+Q40+Q41+Q42+Q43+Q45
                            +Q46+Q48+Q52+Q53/
   19   0                   +Q54+Q55+Q57+Q59+Q60+Q62+Q63+Q65
                            +Q66+Q67+Q68+Q69/
   20   0                   +Q71+Q75
   21   0  If               (Q1 EQ 1) ORG=1
   22   0  If               (Q1 EQ 2) ORG=2
   23   0  If               (Q1 GE 5) ORG=3
   24   0  If               (Q2 EQ 1) POSN=1
   25   0  If               (Q2 EQ 2) POSN=2
   26   0  If               (Q2 EQ 3) POSN=3
```

```
27   0   If              (Q2 EQ 4) POSN=4
28   0   Select If       (ORG EQ 1)
29   0   Frequencies     Variables= MS UND SUC
                         IMP/statistics=all
```

Management Support

MEAN	30.419	STD ERR	.588
MEDIAN	30.000	MODE	30.000
STD DEV	3.856	VARIANCE	14.868
KURTOSIS	.044	S E KURT	.709
SKEWNESS	.279		
S E SKEW	.361	RANGE	17.000
MINIMUM	23.000		
MAXIMUM	40.000	SUM	1308.000

Understanding of MRP

MEAN	99.869	STD ERR	2.431
MEDIAN	99.250	MODE	87.250
STD DEV	15.373	VARIANCE	236.336
KURTOSIS	.264	S E KURT	.733
SKEWNESS	.434		
S E SKEW	.374	RANGE	74.167
MINIMUM	65.000		
MAXIMUM	139.167	SUM	3994.750

Likelihood of Success

MEAN	114.020	STD ERR	2.893
MEDIAN	111.317	MODE	109.500
STD DEV	17.833	VARIANCE	318.023
KURTOSIS	1.133	S E KURT	.750
SKEWNESS	.559		
S E SKEW	.383	RANGE	86.833
MINIMUM	70.333		
MAXIMUM	157.167	SUM	4332.767

Impact of Implementation

MEAN	111.627	STD ERR	2.315
MEDIAN	110.267	MODE	102.500
STD DEV	14.460	VARIANCE	209.092
KURTOSIS	2.881	S E KURT	.741
SKEWNESS	-.567		
S E SKEW	.378	RANGE	79.967
MINIMUM	61.533		
MAXIMUM	141.500	SUM	4353.450

Organization 2: MAB

```
    1  0  Title            'Questionnaire Analysis'
    2  0  File Handle      John/name='mrp.dat'
    3  0  Data List        File=John fixed records=2/
    4  0                   ID Q1 to Q76
    5  0                   (1f8.0,1x,71f1.0/9x,5f1.0)
 THE COMMAND ABOVE READS    2 RECORDS FROM mrp.dat
    6  0  Set              Blanks=99
    7  0  Missing Values   Q1 to Q76 (99)
    8  0  Recode           Q3 to Q76 (7=99)
    9  0  Compute          MS=Q6+Q10+Q14+Q29+Q31+Q36+Q37+Q40
                           +Q58+Q64
   10  0  Compute          UND=Q3+Q7+Q10+Q12+Q25+Q28+Q33+Q34
                           +Q38+Q39+Q40+Q42/
   11  0                   +Q43+Q45+Q46+Q47+Q48+Q49+Q50+Q52
                           +Q53+Q54+Q56+Q58/
   12  0                   +Q60+Q61+Q63+Q65+Q66+Q67+Q68+Q69
                           +Q70
   13  0  Compute          SUC=Q3+Q6+Q9+Q10+Q12+Q13+Q14+Q15
                           +Q16+Q18+Q19+Q21/
   14  0                   +Q23+Q24+Q26+Q27+Q28+Q33+Q34+Q35
                           +Q36+Q38+Q39+Q40/
   15  0                   +Q43+Q47+Q48+Q49+Q54+Q56+Q63+Q67
                           +Q69+Q70+Q71+Q72/
   16  0                   +Q73+Q74+Q75
   17  0  Compute          IMP=Q7+Q11+Q12+Q17+Q18+Q19+Q20
                           +Q21+Q22+Q23+Q29+Q30/
   18  0                   +Q31+Q32+Q34+Q40+Q41+Q42+Q43+Q45
                           +Q46+Q48+Q52+Q53/
   19  0                   +Q54+Q55+Q57+Q59+Q60+Q62+Q63+Q65
                           +Q66+Q67+Q68+Q69/
   20  0                   +Q71+Q75
   21  0  If               (Q1 EQ 1) ORG=1
   22  0  If               (Q1 EQ 2) ORG=2
   23  0  If               (Q1 GE 5) ORG=3
   24  0  If               (Q2 EQ 1) POSN=1
   25  0  If               (Q2 EQ 2) POSN=2
```

```
26   0  If                (Q2 EQ 3) POSN=3
27   0  If                (Q2 EQ 4) POSN=4
28   0  Select If         (ORG EQ 2)
29   0  Frequencies       Variables= MS UND SUC
          IMP/statistics=all
```

Management Support

MEAN	32.436	STD ERR	.585
MEDIAN	32.000	MODE	29.000
STD DEV	4.337	VARIANCE	18.806
KURTOSIS	.655	S E KURT	.634
SKEWNESS	-.314		
S E SKEW	.322	RANGE	23.000
MINIMUM	19.000		
MAXIMUM	42.000	SUM	1784.000

Understanding of MRP

MEAN	103.594	STD ERR	1.980
MEDIAN	105.833	MODE	88.167
STD DEV	13.859	VARIANCE	192.075
KURTOSIS	-.040	S E KURT	.668
SKEWNESS	-.307		
S E SKEW	.340	RANGE	60.000
MINIMUM	70.167		
MAXIMUM	130.167	SUM	5076.117

Likelihood of Success

MEAN	117.303	STD ERR	2.330
MEDIAN	115.983	MODE	135.100
STD DEV	15.453	VARIANCE	238.800
KURTOSIS	-.137	S E KURT	.702
SKEWNESS	.142		
S E SKEW	.357	RANGE	69.467
MINIMUM	82.333		
MAXIMUM	151.800	SUM	5161.333

Impact of Implementation

MEAN	115.482	STD ERR	1.522
MEDIAN	114.867	MODE	109.500
STD DEV	10.435	VARIANCE	108.882
KURTOSIS	-.422	S E KURT	.681
SKEWNESS	-.044		
S E SKEW	.347	RANGE	41.500
MINIMUM	94.900		
MAXIMUM	136.400	SUM	5427.633

Organization 3: Headquarters

```
    1   0  Title            'Questionnaire Analysis'
    2   0  File Handle      John/name='mrp.dat'
    3   0  Data List        File=John fixed records=2/
    4   0                   ID Q1 to Q76
    5   0                   (1f8.0,1x,71f1.0/9x,5f1.0)
 THE COMMAND ABOVE READS    2 RECORDS FROM mrp.dat
    6   0  Set              Blanks=99
    7   0  Missing Values   Q1 to Q76 (99)
    8   0  Recode           Q3 to Q76 (7=99)
    9   0  Compute          MS=Q6+Q10+Q14+Q29+Q31+Q36+Q37+Q40
                            +Q58+Q64
   10   0  Compute          UND=Q3+Q7+Q10+Q12+Q25+Q28+Q33+Q34
                            +Q38+Q39+Q40+Q42/
   11   0                   +Q43+Q45+Q46+Q47+Q48+Q49+Q50+Q52
                            +Q53+Q54+Q56+Q58/
   12   0                   +Q60+Q61+Q63+Q65+Q66+Q67+Q68+Q69
                            +Q70
   13   0  Compute          SUC=Q3+Q6+Q9+Q10+Q12+Q13+Q14+Q15
                            +Q16+Q18+Q19+Q21/
   14   0                   +Q23+Q24+Q26+Q27+Q28+Q33+Q34+Q35
                            +Q36+Q38+Q39+Q40/
   15   0                   +Q43+Q47+Q48+Q49+Q54+Q56+Q63+Q67
                            +Q69+Q70+Q71+Q72/
   16   0                   +Q73+Q74+Q75
   17   0  Compute          IMP=Q7+Q11+Q12+Q17+Q18+Q19+Q20
                            +Q21+Q22+Q23+Q29+Q30/
   18   0                   +Q31+Q32+Q34+Q40+Q41+Q42+Q43+Q45
                            +Q46+Q48+Q52+Q53/
   19   0                   +Q54+Q55+Q57+Q59+Q60+Q62+Q63+Q65
                            +Q66+Q67+Q68+Q69/
   20   0                   +Q71+Q75
   21   0  If               (Q1 EQ 1) ORG=1
   22   0  If               (Q1 EQ 2) ORG=2
   23   0  If               (Q1 GE 5) ORG=3
   24   0  If               (Q2 EQ 1) POSN=1
```

```
25   0  If                (Q2 EQ 2) POSN=2
26   0  If                (Q2 EQ 3) POSN=3
27   0  If                (Q2 EQ 4) POSN=4
28   0  Select If         (ORG EQ 2)
29   0  Frequencies       Variables= MS UND SUC
          IMP/statistics=all
```

Management Support

MEAN	33.000	STD ERR	.820
MEDIAN	34.000	MODE	34.000
STD DEV	2.720	VARIANCE	7.400
KURTOSIS	-.504	S E KURT	1.279
SKEWNESS	-.765		
S E SKEW	.661	RANGE	8.000
MINIMUM	28.000		
MAXIMUM	36.000	SUM	363.000

Understanding of MRP

MEAN	102.430	STD ERR	1.733
MEDIAN	104.250	MODE	91.500
STD DEV	5.749	VARIANCE	33.047
KURTOSIS	-.492	S E KURT	1.279
SKEWNESS	-.785		
S E SKEW	.661	RANGE	18.000
MINIMUM	91.500		
MAXIMUM	109.500	SUM	1126.733

Likelihood of Success

MEAN	121.950	STD ERR	2.981
MEDIAN	124.583	MODE	95.400
STD DEV	9.886	VARIANCE	97.732
KURTOSIS	5.612	S E KURT	1.279
SKEWNESS	-2.200		
S E SKEW	.661	RANGE	34.667
MINIMUM	95.400		
MAXIMUM	130.067	SUM	1341.450

Impact of Implementation

MEAN	125.535	STD ERR	4.483
MEDIAN	131.267	MODE	98.400
STD DEV	14.869	VARIANCE	221.101
KURTOSIS	-.527	S E KURT	1.279
SKEWNESS	-.676		
S E SKEW	.661	RANGE	44.783
MINIMUM	98.400		
MAXIMUM	143.183	SUM	1380.883

Appendix J: ANOVA and Tukey by Category, Controlling for Organization

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze differences between organizations in each question category.

Sample Program

```
    1   0  Title            'Questionnaire Analysis'
    2   0  File Handle      John/name='mrp.dat'
    3   0  Data List        File=John fixed records=2/
    4   0                   ID Q1 to Q76
    5   0                   (1f8.0,1x,71f1.0/9x,5f1.0)
 THE COMMAND ABOVE READS    2 RECORDS FROM mrp.dat
    6   0  Set              Blanks=99
    7   0  Missing Values   Q1 to Q76 (99)
    8   0  Recode           Q3 to Q76 (7=99)
    9   0  Compute          MS=Q6+Q10+Q14+Q29+Q31+Q36+Q37
                            +Q40+Q58+Q64
   10   0  Compute          UND=Q3+Q7+Q10+Q12+Q25+Q28+Q33+Q34
                            +Q38+Q39+Q40+Q42/
   11   0                   +Q43+Q45+Q46+Q47+Q48+Q49+Q50+Q52
                            +Q53+Q54+Q56+Q58/
   12   0                   +Q60+Q61+Q63+Q65+Q66+Q67+Q68+Q69
                            +Q70
   13   0  Compute          SUC=Q3+Q6+Q9+Q10+Q12+Q13+Q14+Q15
                            +Q16+Q18+Q19+Q21/
   14   0                   +Q23+Q24+Q26+Q27+Q28+Q33+Q34+Q35
                            +Q36+Q38+Q39+Q40/
   15   0                   +Q43+Q47+Q48+Q49+Q54+Q56+Q63+Q67
                            +Q69+Q70+Q71+Q72/
   16   0                   +Q73+Q74+Q75
   17   0  Compute          IMP=Q7+Q11+Q12+Q17+Q18+Q19+Q20+Q21
                            +Q22+Q23+Q29+Q30/
   18   0                   +Q31+Q32+Q34+Q40+Q41+Q42+Q43+Q45
                            +Q46+Q48+Q52+Q53/
   19   0                   +Q54+Q55+Q57+Q59+Q60+Q62+Q63+Q65
                            +Q66+Q67+Q68+Q69/
   20   0                   +Q71+Q75
   21   0  If               (Q1 EQ 1) ORG=1
   22   0  If               (Q1 EQ 2) ORG=2
   23   0  If               (Q1 GE 5) ORG=3
```

```
24  0  If              (Q2 EQ 1) POSN=1
25  0  If              (Q2 EQ 2) POSN=2
26  0  If              (Q2 EQ 3) POSN=3
27  0  If              (Q2 EQ 4) POSN=4
28  0  Oneway          MS UND SUC IMP by Q1(1,7)/
29  0    Ranges=Tukey
30  0  Statistics      All
```

Sample Output

```
     Variable  MS
  By Variable  Q1
```

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5	257.9076	51.5815	2.8882	.0172
WITHIN GROUPS	113	2018.0924	17.8592		
TOTAL	118	2276.0000			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MIN	MAX	95% MEAN CI
Grp 1	43	30.4186	3.8559	.5880	23	40	29.23-31.60
Grp 2	55	32.4364	4.3366	.5847	19	42	31.26-33.61
Grp 4	10	35.3000	6.0009	1.8977	28	44	31.01-39.59
Grp 5	6	33.0000	2.8284	1.1547	28	36	30.03-35.97
Grp 6	4	34.0000	2.1602	1.0801	31	36	30.56-37.44
Grp 7	1	29.0000					
TOTAL	119	32.0000	4.3918	.4026	19	44	31.20-32.80
FIXED EFFECTS MODEL		4.2260	.3874				31.23-32.77
RANDOM EFFECTS MODEL			.9643				29.52-34.48

RANDOM EFFECTS MODEL - ESTIMATE OF BETWEEN COMPONENT VARIANCE 2.1967

Tests for Homogeneity of Variances

Cochrans C = Max. Variance/Sum(Variances)=.4373, P =.000
(Approx.)
Bartlett-Box F = 1.589 , P = .174
Maximum Variance / Minimum Variance 7.717

Variable MS
By Variable Q1

MULTIPLE RANGE TEST

TUKEY-HSD PROCEDURE
RANGES FOR THE 0.050 LEVEL -

4.10 4.10 4.10 4.10 4.10

THE RANGES ABOVE ARE TABLE RANGES.
THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
2.9882 * RANGE * DSQRT(1/N(I) + 1/N(J))

(*) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL

		G r p 7	G r p 1	G r p 2	G r p 5	G r p 6	G r p 4
Mean	Group						
29.0000	Grp 7						
30.4186	Grp 1						
32.4364	Grp 2						
33.0000	Grp 5						
34.0000	Grp 6						
35.3000	Grp 4			*			

Appendix K: ANOVA and Tukey by Category, Controlling for Duty Position

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze the differences between duty positions in each question category.

Sample Program

```
    1   0  Title              'Questionnaire Analysis'
    2   0  File Handle        John/name='mrp.dat'
    3   0  Data List          File=John fixed records=2/
    4   0                     ID Q1 to Q76
    5   0                     (1f8.0,1x,71f1.0/9x,5f1.0)
 THE COMMAND ABOVE READS    2 RECORDS FROM mrp.dat
    6   0  Set                Blanks=99
    7   0  Missing Values     Q1 to Q76 (99)
    8   0  Recode             Q3 to Q76 (7=99)
    9   0  Compute            MS=Q6+Q10+Q14+Q29+Q31+Q36
                              +Q37+Q40+Q58+Q64
   10   0  Compute            UND=Q3+Q7+Q10+Q12+Q25+Q28+Q33+Q34
                              +Q38+Q39+Q40+Q42/
   11   0                     +Q43+Q45+Q46+Q47+Q48+Q49+Q50
                              +Q52+Q53+Q54+Q56+Q58/
   12   0                     +Q60+Q61+Q63+Q65+Q66+Q67+Q68+Q69
                              +Q70
   13   0  Compute            SUC=Q3+Q6+Q9+Q10+Q12+Q13+Q14+Q15
                              +Q16+Q18+Q19+Q21/
   14   0                     +Q23+Q24+Q26+Q27+Q28+Q33+Q34+Q35
                              +Q36+Q38+Q39+Q40/
   15   0                     +Q43+Q47+Q48+Q49+Q54+Q56+Q63+Q67
                              +Q69+Q70+Q71+Q72/
   16   0                     +Q73+Q74+Q75
   17   0  Compute            IMP=Q7+Q11+Q12+Q17+Q18+Q19+Q20+Q21
                              +Q22+Q23+Q29+Q30/
   18   0                     +Q31+Q32+Q34+Q40+Q41+Q42+Q43+Q45
                              +Q46+Q48+Q52+Q53/
   19   0                     +Q54+Q55+Q57+Q59+Q60+Q62+Q63+Q65
                              +Q66+Q67+Q68+Q69/
   20   0                     +Q71+Q75
   21   0  If                 (Q1 EQ 1) ORG=1
   22   0  If                 (Q1 EQ 2) ORG=2
   23   0  If                 (Q1 GE 5) ORG=3
```

```
22  0  If              (Q1 EQ 2) ORG=2
23  0  If              (Q1 GE 5) ORG=3
24  0  If              (Q2 EQ 1) POSN=1
25  0  If              (Q2 EQ 2) POSN=2
26  0  If              (Q2 EQ 3) POSN=3
27  0  If              (Q2 EQ 4) POSN=4
28  0  Oneway          MS UND SUC IMP by Q2(1,7)/
29  0    Ranges=Tukey
30  0  Statistics      All
```

Sample Output

```
     Variable  MS
  By Variable  Q2
```

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3	107.7670	35.9223	1.9053	.1326
WITHIN GROUPS	115	2168.2330	18.8542		
TOTAL	118	2276.0000			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MIN	MAX	95% MEAN CI
Grp 1	19	31.8421	2.7741	.6364	26	37	30.51-33.18
Grp 2	45	31.8000	4.7844	.7132	19	42	30.36-33.24
Grp 3	25	30.7200	3.2213	.6443	24	39	29.39-32.05
Grp 4	30	33.4667	5.1644	.9429	23	44	31.54-35.40
TOTAL	119	32.0000	4.3918	.4026	19	44	31.20-32.80
FIXED EFFECTS MODEL		4.3421	.3980				31.21-32.79
RANDOM EFFECTS MODEL			.5680				30.19-33.81

RANDOM EFFECTS MODEL - ESTIMATE OF BETWEEN COMPONENT VARIANCE 0.5945

Tests for Homogeneity of Variances

Cochrans C = Max. Variance/Sum(Variances) =.3943, P =.037
(Approx.)
Bartlett-Box F =3.894 , P = .009
Maximum Variance / Minimum Variance 3.466
Variable MS
By Variable Q2

MULTIPLE RANGE TEST

TUKEY-HSD PROCEDURE
RANGES FOR THE 0.050 LEVEL -

3.69 3.69 3.69

THE RANGES ABOVE ARE TABLE RANGES.
THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
3.0704 * RANGE * DSQRT(1/N(I) + 1/N(J))
- NO TWO GROUPS ARE SIGNIFICANTLY DIFFERENT AT THE 0.050
LEVEL

Appendix L: Frequencies by Question, Controlling for Organization

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze each question's response frequencies, controlling for organization.

Sample Program

```
  1  0  Title            'Questionnaire Analysis'
  2  0  File Handle     John/name='mrp.dat'
  3  0  Data List       File=John fixed records=2/
  4  0                  ID Ques1 to Ques76
  5  0                  (1f8.0,1x,71f1.0/9x,5f1.0)

 THE COMMAND ABOVE READS   2 RECORDS FROM mrp.dat

  6  0  Set              Blanks=99
  7  0  Missing Values  Ques1 to Ques76 (99)
  8  0  Recode           Ques3 to Ques76 (7=99)
  9  0  Recode           Ques15 Ques61 (1=6) (2=5) (3=4)
                        (4=3) (5=2) (6=1)
 10  0  If               (Ques1 EQ 1) ORG=1
 11  0  If               (Ques1 EQ 2) ORG=2
 12  0  If               (Ques1 GE 5) ORG=3
 13  0  If               (Ques2 EQ 1) POSN=1
 14  0  If               (Ques2 EQ 2) POSN=2
 15  0  If               (Ques2 EQ 3) POSN=3
 16  0  If               (Ques2 EQ 4) POSN=4
 17  0  Select If        (ORG EQ 1)
 18  0  Frequencies      Variables= Ques3 to
                        Ques76/stastistics = all/
```

Sample Output

QUES3

VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
1	13	23.2	23.2	23.2
2	19	33.9	33.9	57.1
3	13	23.2	23.2	80.4
4	3	5.4	5.4	85.7
5	5	8.9	8.9	94.6
6	3	5.4	5.4	100.0
TOTAL	56	100.0	100.0	

MEAN	2.589	STD ERR	.190	MEDIAN	2.000
MODE	2.000	STD DEV	1.424	VARIANCE	2.028
KURTOSIS	.143	S E KURT	.628	SKEWNESS	.929
S E SKEW	.319	RANGE	5.000	MINIMUM	1.000
MAXIMUM	6.000	SUM	145.000		

VALID CASES 56 MISSING CASES 0

QUES4

VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
1	9	16.1	16.1	16.1
2	17	30.4	30.4	46.4
3	16	28.6	28.6	75.0
4	5	8.9	8.9	83.9
5	8	14.3	14.3	98.2
6	1	1.8	1.8	100.0
TOTAL	56	100.0	100.0	

MEAN	2.804	STD ERR	.177	MEDIAN	3.000
MODE	2.000	STD DEV	1.327	VARIANCE	1.761
KURTOSIS	-.534	S E KURT	.628	SKEWNESS	.520
S E SKEW	.319	RANGE	5.000	MINIMUM	1.000
MAXIMUM	6.000	SUM	157.000		

VALID CASES 56 MISSING CASES 0

Appendix M: Frequencies by Question, Controlling for Duty Position

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze each question's response frequencies, controlling for duty position.

Sample Program

```
  1   0  Title            'Questionnaire Analysis'
  2   0  File Handle      John/name='mrp.dat'
  3   0  Data List        File=John fixed records=2/
  4   0                   ID Ques1 to Ques76
  5   0                   (1f8.0,1x,71f1.0/9x,5f1.0)

THE COMMAND ABOVE READS   2 RECORDS FROM mrp.dat

  6   0  Set              Blanks=99
  7   0  Missing Values   Ques1 to Ques76 (99)
  8   0  Recode           Ques3 to Ques76 (7=99)
  9   0  Recode           Ques15 Ques61 (1=6) (2=5) (3=4)
                          (4=3) (5=2) (6=1)
 10   0  If               (Ques1 EQ 1) ORG=1
 11   0  If               (Ques1 EQ 2) ORG=2
 12   0  If               (Ques1 GE 5) ORG=3
 13   0  If               (Ques2 EQ 1) POSN=1
 14   0  If               (Ques2 EQ 2) POSN=2
 15   0  If               (Ques2 EQ 3) POSN=3
 16   0  If               (Ques2 EQ 4) POSN=4
 17   0  Select If        (POSN EQ 1)
 18   0  Frequencies      Variables= Ques3 to
                          Ques76/stastistics = all/
```

Sample Output

QUES3

VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
1	9	36.0	36.0	36.0
2	5	20.0	20.0	56.0
3	5	20.0	20.0	76.0
4	1	4.0	4.0	80.0
5	5	20.0	20.0	100.0
TOTAL	25	100.0	100.0	

MEAN	2.520	STD ERR	.306	MEDIAN	2.000
MODE	1.000	STD DEV	1.531	VARIANCE	2.343
KURTOSIS	-1.050	S E KURT	.902	SKEWNESS	.603
S E SKEW	.464	RANGE	4.000	MINIMUM	1.000
MAXIMUM	5.000	SUM	63.000		

VALID CASES 25 MISSING CASES 0

QUES4

VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
1	2	8.0	8.0	8.0
2	9	36.0	36.0	44.0
3	7	28.0	28.0	72.0
5	6	24.0	24.0	96.0
6	1	4.0	4.0	100.0
TOTAL	25	100.0	100.0	

MEAN	3.080	STD ERR	.288	MEDIAN	3.000
MODE	2.000	STD DEV	1.441	VARIANCE	2.077
KURTOSIS	-.884	S E KURT	.902	SKEWNESS	.575
S E SKEW	.464	RANGE	5.000	MINIMUM	1.000
MAXIMUM	6.000	SUM	77.000		

VALID CASES 25 MISSING CASES 0

Appendix N: ANOVA and Tukey by Question, Controlling for Duty Position

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze each question for differences in responses by duty position (question 2).

Sample Program

```
    1   0  Title           'Questionnaire Analysis'
    2   0  File Handle     John/name='mrp.dat'
    3   0  Data List       File=John fixed records=2/
    4   0                  ID Ques1 to Ques76
    5   0                  (1f8.0,1x,71f1.0/9x,5f1.0)

 THE COMMAND ABOVE READS   2 RECORDS FROM mrp.dat

    6   0  Set             Blanks=99
    7   0  Missing Values  Ques1 to Ques76 (99)
    8   0  Recode          Ques3 to Ques76 (7=99)
    9   0  Oneway          Ques3 to Ques76 by Ques2 (1,7)/
   10   0    Ranges=Tukey
   11   0  Statistics      All
```

Sample Output

```
        Variable  QUES3
    By Variable  QUES2

                        ANALYSIS OF VARIANCE

                                SUM OF      MEAN        F         F
        SOURCE        D.F       SQUARES     SQUARES     RATIO     PROB.

 BETWEEN GROUPS        3       15.2323      5.0774     2.4806    .0636

 WITHIN GROUPS       141      288.6022      2.0468

 TOTAL               144      303.8345
```

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MIN	MAX	95% MEAN CI
Grp 1	25	2.5200	1.5308	.3062	1	5	1.89-3.15
Grp 2	51	2.8235	1.3958	.1954	1	6	2.43-3.22
Grp 3	35	2.2571	1.1966	.2023	1	5	1.85-2.67
Grp 4	34	3.1471	1.6168	.2773	1	6	2.58-3.71
TOTAL	145	2.7103	1.4526	.1206	1	6	2.47-2.95
FIXED EFFECTS MODEL			1.4307	.1188			2.48-2.95
RANDOM EFFECTS MODEL				.1921			2.10-3.32

RANDOM EFFECTS MODEL - ESTIMATE OF BETWEEN COMPONENT VARIANCE 0.0855

Tests for Homogeneity of Variances

Cochrans C = Max. Variance/Sum(Variances) = .3135, P = .452 (Approx.)
Bartlett-Box F = 1.085 , P = .354
Maximum Variance / Minimum Variance 1.826

Variable QUES3
By Variable QUES2
MULTIPLE RANGE TEST

TUKEY-HSD PROCEDURE
RANGES FOR THE 0.050 LEVEL -

3.68 3.68 3.68

THE RANGES ABOVE ARE TABLE RANGES.
THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
1.0116 * RANGE * DSQRT(1/N(I) + 1/N(J))
- NO TWO GROUPS ARE SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL

Appendix Q: ANOVA and Tukey by Question, Controlling for Organization

This Appendix contains an SPSS-X program and a sample of output. The output was used to analyze each question for differences in responses by organization (question 1).

Sample Program

```
  1  0  Title            'Questionnaire Analysis'
  2  0  File Handle     John/name='mrp.dat'
  3  0  Data List       File=John fixed records=2/
  4  0                  ID Ques1 to Ques76
  5  0                  (1f8.0,1x,71f1.0/9x,5f1.0)

THE COMMAND ABOVE READS   2 RECORDS FROM mrp.dat

  6  0  Set              Blanks=99
  7  0  Missing Values  Ques1 to Ques76 (99)
  8  0  Recode           Ques3 to Ques76 (7=99)
  9  0  Oneway           Ques3 to Ques76 by Ques1 (1,7)/
 10  0    Ranges=Tukey
 11  0  Statistics       All
```

Sample Output

```
     Variable  QUES3
  By Variable  QUES1
```

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5	12.1343	2.4269	1.1564	.3338
WITHIN GROUPS	139	291.7002	2.0986		

TOTAL 144 303.8345

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MIN	MAX	95% MEAN CI
Grp 1	56	2.5893	1.4242	.1903	1	6	2.21-2.97
Grp 2	64	2.8438	1.4608	.1826	1	6	2.48-3.21
Grp 4	11	2.0909	1.4460	.4360	1	6	1.12-3.06
Grp 5	8	3.0000	1.5119	.5345	1	5	1.74-4.26
Grp 6	5	2.8000	1.4832	.6633	1	5	.96-4.64
Grp 7	1	5.0000					
TOTAL	145	2.7103	1.4526	.1206	1	6	2.47-2.95
FIXED EFFECTS MODEL			1.4486	.1203			2.47-2.95
RANDOM EFFECTS MODEL				.1438			2.34-3.08

RANDOM EFFECTS MODEL - ESTIMATE OF BETWEEN COMPONENT VARIANCE 0.0175

Tests for Homogeneity of Variances

Cochrans C = Max. Variance/Sum(Variances) = .2128, P = 1.000 (Approx.)
Bartlett-Box F =.017 , P = .999
Maximum Variance / Minimum Variance 1.127

MULTIPLE RANGE TEST

TUKEY-HSD PROCEDURE
RANGES FOR THE 0.050 LEVEL -

4.09 4.09 4.09 4.09 4.09

THE RANGES ABOVE ARE TABLE RANGES.
THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
1.0243 * RANGE * DSQRT(1/N(I) + 1/N(J))
- NO TWO GROUPS ARE SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL

Bibliography

1. American Production and Inventory Control Society Dictionary (Sixth Edition). American Production and Inventory Control Society, Inc., 1987.

2. Anderson, John C. and others. "Material Requirements Planning Systems: The State of the Art," Production and Inventory Control, 51-65, (Fourth Quarter 1982).

3. -----. "MRP: A Study of Implementation and Practice," Monograph published by APICS, 1981.

4. Belt, Bill. "Men, Spindles and Material Requirements Planning: Enhancing Implementation, "Production and Inventory Management, 54-65, (First Quarter 1979).

5. Bevis, George E. "A Management Viewpoint on the Implementation of a MRP System," Production and Inventory Management, 105-116, (First Quarter 1976).

6. Boeder, Steven M. "Large System Benefits for the Small Manufacturing Environment," APICS 29th Annual International Conference Proceedings, 32-39, 1986.

7. Cavinato, Joseph. "Don't Be Afraid to Kick MRP's Tires," Distribution, 102, August 1987.

8. Clark, Steven J. and others. "How to Evaluate Your Material Requirements Planning System," Production and Inventory Management, 15-32, (Third Quarter 1982).

9. Clay, Peter. "Material Availability Planning: 3-D MRP," APICS 28th International Conference Proceedings. 293-297, 1985.

10. Clover, Vernon T. and Howard L. Balsley. Business Research Methods. Columbus, Ohio: Grid Publishing Inc., 1979.

11. Cobbin, Phillip. SIMPLE 1 Reference Manual. Campbell, California: Sierra Simulations and Software, 1987.

12. Cox, James F. and others. "Auditing an MRP System," Academy of Management Journal, 386-402, (Second Quarter 1981).

13. Davis, Captain Carl L. Class lecture in COMM 630, Research Methods. School of Systems and Logistics, Air Force Institute of Technology (AU) Wright-Patterson AFB OH, 25 January 1989.

14. DiPrima, Michael R. "Record Accuracy: A Key to Ensuring That JIT Doesn't Become a Jump Into Trouble," APICS 28th Annual International Conference Proceedings, 289-292, 1985.

15. Emory, C. William. Business Research Methods. Homewood IL: Richard D. Irwin, Inc., 1985.

16. Ferber, Robert and P.J. Verdoorn. Research Methods in Economics and Business. Toronto: The Macmillan Co., 1962.

17. Finnern, Major Michael L. A Case Study of the Implementation of Manufacturing Resource Planning at the Ogden Air Logistics Center. MS Thesis, AFIT/GLM/LSM/88S-18. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1988.

18. Fox, William F. "Achieving Class A MRP: An Implementation Reviewed," APICS 28th International Conference Proceedings, 304-307, 1985.

19. Gilbert, James P. and Richard J. Schonberger. "Inventory Based Control Systems: A Historical Analysis," Material Requirements Planning Reprints, 1-13, 1986.

20. Hartley, Kenneth. "How to Plan and Organize an MRP Project," Material Requirements Reprints, 185-197, 1986.

21. Hinds, Stanley W. "The Spirit of Material Requirements Planning," Production and Inventory Management, 35-50, (Fourth Quarter 1982).

22. Iemmolo, George R. "We're On Our Way to Class A: A System Reimplementation," APICS 28th Annual International Conference Proceedings, 283-286, 1985.

23. Krupp, James A. G. "Why MRP Systems Fail: Traps to Avoid," Material Requirements Reprints, 207-212, 1986.

24. Maertz, William E. "MRP's Fourth Requirement," Production and Inventory Management, 81-86, (Third Quarter 1979).

25. Meredith, Jack R. The Management of Operations (Third Edition). New York: John Wiley & Sons, 1987.

26. Miller, Jeffery G. and Linda G. Sprague. "Behind the Growth in Materials Requirements Planning," Harvard Business Review, 83-91, September-October 1975.

27. "MRP Symposium," Production and Inventory Management, 29-39, (Second Quarter 1977).

28. Orlicky, Joseph. Materials Requirements Planning. New York: McGraw-Hill Book Co., 1975.

29. Orlicky, Joseph and others. "Structuring the Bill of Materials for MRP," Production and Inventory Management, 19-42, (Fourth Quarter 1972).

30. Plossl, George and Oliver Wight. "Designing and Implememting a Material Requirements Planning System," APICS 13th Annual Conference Proceedings, 12-33, 1970.

31. Roberts, Barry J. "Education and Training Support Programs to Support MRP Implementations, "Production and Inventory Management, 45-50, (Second Quarter 1982).

32. Sanders, Rufus C. "MRP-Mirage or Miracle," Infosystems, 62-65, December 1977.

33. Schuchts, David R. "Give MRP A Kiss," Production and Inventory Management, 68-80, (Third Quarter 1979).

34. Smiley, Steven J. "MRP: Getting It Right the Second Time," APICS 28th International Conference Proceedings, 301-303, 1985.

35. Smolik, Donald P. Material Requirements for Manufacturing. New York: Van Nostrand Reinhold Co., 1983.

36. Teplitz, Charles J. "MRP Can Work In Your Job Shop!" Production and Inventory Management, 21-26, (Fourth Quarter 1976).

37. Thompson, Terri. "MRP: A Good Idea, But Can You Make It Work?" Purchasing, 71-75, 28 February 1980.

38. Wallace, Thomas F. MRP II: Making It Happen. Essex Junction VT: The Oliver Wight Companies, 1985.

39. Whybark, D. Clay. "MRP: A Profitable Concept for Distribution," Production Planning, Scheduling, and Inventory Control. Atlanta: Industrial Engineering and Management Press, 1986.

40. Wight, Oliver W. MRP II: Unlocking America's Productivity Potential. CBI Publishing Co., Inc., 1981.

41. -----. The Executives Guide to Successful MRP II. Englewood Cliffs NJ: Prentice-Hall, Inc., 1982.

42. -----. "Tools for Profit," Datamation, 83-85, October 1980.

VITA

Captain John M. Faulkner [redacted] He graduated from Bethel Park Senior High School, Bethel Park, Pennsylvania in 1975. In April of 1979, Captain Faulkner graduated from the University of Pittsburgh with a BS in Chemistry. He received his commission in the United States Air Force 1 May 1979, entering active duty at Vandenberg AFB, California in June. His first assignment after completing ICBM Initial Qualification Training was to Grand Forks AFB, North Dakota, as a Launch Control Officer. While at Grand Forks, other duties included missile crew evaluator, Missile Combat Competition crew member, Missile Crew Commander, Wing Command Post Emergency Actions Controller, and Emergency War Order Instructor. Additionally he earned an MBA from the University of North Dakota. Captain Faulkner was assigned to the Headquarters SAC Command Center, Offutt AFB, Nebraska as an Emergency Actions Controller in 1984. Other duties at Offutt included Command Center Training Officer and Deputy Chief of the Command Control Briefing Branch. In 1988 Captain Faulkner entered the School of Systems and Logistics, Air Force Institute of Technology.

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Larry W. Emmelhainz

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Wright-Patterson AFB OH 45433-6583

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The research examines Manufacturing Resource Planning (MRP II) implementation at the Ogden Air Logistics Center (OOALC), Hill AFB, Utah. This study is a follow-up to a thesis which focused specifically on the Industrial Products and Landing Gear Division at OOALC, accomplished in 1988.

The research is divided into three areas: an historical perspective of the implementation; analysis of previously identified problem areas; and a discussion on success probability. Each area is discussed and analyzed based on primary and secondary data.

Literature is reviewed with particular emphasis placed on the basic elements of a MRP II system and the recommended path to implementation success. This secondary information was later contrasted with the data collected specifically for this research.

Information for the study was collected using personal interviews and a questionnaire. Data sources were used in Headquarters, Air Force Logistics Command and at OOALC. The information from each data collection instrument was complementary and provided supporting data for the conclusions.

The research concludes that while the personal commitment and abilities of those involved with the project are exemplary, the plan and constraints on the implementation may undermine the chances of project success.

Recommendations for improving the chances of success are also included. Additionally, encouragement for future study is offered.